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14. ABSTRACT
Purpose: To extend MilNOD to additional sites and to determine the associations between nurse staffing and patient and nurse outcomes. **Design**: This observational, correlational study included multiple sources of data: prospectively collected longitudinal staffing, retrospectively collected adverse events, cross-sectional nursing and patient surveys, and annual pressure ulcer and restraint prevalence surveys. **Methods**: The following indicators were collected at the nursing unit: nurse staffing, patient days, patient turnover, and patient acuity. Patient falls and nurse medication administration errors were extracted from occurrence reports. Nurse needlestick injuries were obtained from occupational health or risk management reports. Pressure ulcer and restraint data were collected by prevalence survey at least annually. Annual nursing surveys included education, experience, job satisfaction, and an evaluation of the nursing work environment. Patient surveys included satisfaction with care. **Sample**: The sample includes over 115,000 shifts from 57 units in 13 military hospitals; 1586 nursing surveys; 1721 patient satisfaction surveys; and 1684 pressure ulcer/restraint prevalence participants. **Instrumentation**: The Patient Satisfaction with Nursing Care Questionnaire, the Practice Environment Scale of the Nursing Work Index, and a series of single item measures were used. **Analysis**: Bayesian hierarchical logistic regression analysis was used to examine shift level staffing associations with adverse events. Hierarchical linear models were used to analyze nurse job satisfaction, patient satisfaction, and work environment outcomes. **Findings**: There were substantial effects of staffing on adverse events at the shift level, such that better RN skill mix, more hours of care, and a higher proportion of civilian staff resulted in lower patient and nurse adverse events. Patient satisfaction was high and invariant between hospitals. Nurse satisfaction had no staffing associations but was strongly influenced by position. **Implications**: The MilNOD project resulted in a capacity to collect and use valid, reliable, and comparable quality indicator data to advance the potential for patient outcome benchmarking and evidence-based decision support.

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Abstract

The Military Nursing Outcomes Database: Analysis and Expansion

Purpose: To extend MilNOD to additional sites and to determine the associations between nurse staffing and patient and nurse outcomes.

Design: This observational, correlational study included multiple sources of data: prospectively collected longitudinal staffing, retrospectively collected adverse events, cross-sectional nursing and patient surveys, and annual pressure ulcer and restraint prevalence surveys.

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Sample: The sample includes over 115,000 shifts from 57 units in 13 military hospitals; 1586 nursing surveys; 1721 patient satisfaction surveys; and 1684 pressure ulcer/restraint prevalence participants.

Instrumentation: The Patient Satisfaction with Nursing Care Questionnaire, the Practice Environment Scale of the Nursing Work Index, and a series of single item measures were used.

Analysis: Bayesian hierarchical logistic regression analysis was used to examine shift level staffing associations with adverse events. Hierarchical linear models were used to analyze nurse job satisfaction, patient satisfaction, and work environment outcomes.

Findings: There were substantial effects of staffing on adverse events at the shift level, such that better RN skill mix, more hours of care, and a higher proportion of civilian staff resulted in lower patient and nurse adverse events. Patient satisfaction was high and invariant between hospitals. Nurse satisfaction had no staffing associations but was strongly influenced by position.

Implications: The MilNOD project resulted in a capacity to collect and use valid, reliable, and comparable quality indicator data to advance the potential for patient outcome benchmarking and evidence-based decision support.

Introduction

Today's health care system is largely the product of payment reform and redesign efforts of the past 20 years. In the 1980s, because of prospective payment policies, patients were discharged from hospitals "sicker and quicker", requiring nurses to be exceptionally competent to manage the needs of highly complex patients in a compressed time period. The turbulence and chaos in health care escalated in the 1990s as restructuring efforts changed the composition of the hospital workforce by reducing nursing staff despite the heightened patient acuity in all care settings (Aiken, Clarke & Sloane, 2000; Aiken & Fagin, 1997; Aiken, Sochalski & Lake, 1997; Committee on Quality of Health Care in America, 2001; Curran & Mazzie; 1995; Kohn, Corrigan, & Donaldson, 1999; Shindul-Rothschild, Berry & Long-Middleton, 1996; Tillman, Salyer, Corley & Mark, 1997; Walston, Burns, & Kimberly, 2000; Wiener, 2000; Wunderlich, Sloan & Davis, 1996).

Whereas cost was the prevailing issue in health care in the past, quality has now moved into the foreground. Critical examinations of health care quality commenced with the release of the report from the President's Advisory Commission on Consumer Protection and Quality in the Health Care Industry (1998). Shortly thereafter, the Institute of Medicine's (IOM) report on patient safety (Kohn, Corrigan & Donaldson, 2000) catapulted quality issues into prominence as the number one national health care concern. Deficiencies in patient safety issues in particular and quality care in general were being exposed at the same time that workforce issues in several health professions were emerging (Aiken et al., 2001; Buerhaus & Staiger, 1999; Committee on Quality of Health Care in America, 2001; Bates et al., 1997). These workforce issues suggest there may be serious and protracted, perhaps even irreversible, consequences of staffing shortages and work environment problems that may further compromise the quality of care and patient safety (Hinshaw & McClure, 2001). Since that time, subsequent reports have called attention to the work environment of hospital nurses as being another source of patient safety and quality care concerns (Patrician, Shang, & Lake, 2010; Page, 2004).

Nurses have been called the "backbone of the health industry" (Altman, 1971, p. 1). For acute, inpatient care, it is accepted that patients are admitted to hospitals for the purpose of receiving nursing care. It is therefore not surprising that nurses are viewed as a safety net for the health care system by virtue of their constant presence and proximity to patients where a significant number of preventable errors occur (Foley, 1999). If there is a gap in quality, nurses are at the patient's side to catch problems and intervene before mistakes happen. Hence, nurses are the last line of defense before system errors reach the patient.

Although it is disconcerting, it is not entirely surprising that inflammatory media allegations point the finger of blame at nurses for compromises in patient safety (Berens, 2000). Among the many aspects surrounding patient safety that the press failed to note is one articulated by Wakefield (2001)—inadequate nurse staffing places patient care in jeopardy. But nurses alone cannot be held accountable when those who

establish policies and make decisions fail to consider that staffing may improve or compromise patient safety.

The absence of data for decision-making feeds the cycle of targeting nursing for further reductions when cost containment is necessary and then for holding nursing accountable when patient safety and quality dip below the level of acceptability. The absence of these data is no longer tenable. Such data are central to strategic planning, policy decisions, financial stability, as well as patient safety and quality. "It is ironic that hospitals have long entrusted major portions of their budgets to nurse managers, yet have provided few tools . . . for ensuring that the core business of the institution—nursing—was being well-managed" (Diers, Weaver, Bozzo, Allegretto, & Pollack, 1998, p. 108). It is time to reverse this irony. And that was the goal of this project—to create a database with valid and reliable nursing data that will ultimately support the serious and appropriate appraisal of staffing effectiveness and nursing's contribution to patient safety and quality care.

The Military Nursing Workforce: An Army Snapshot

The military nursing workforce is a combination of active duty, reserve, career civilian and contract nurses. Because of nursing roles in support of the readiness mission, this workforce is also a blend of Registered Nurses (RNs), Licensed Practical Nurses (LPNs), and unlicensed assistive personnel, such as nursing assistants, combat medics, corpsmen, and technicians. The composition of the military active duty and reserve nursing workforce is prescribed by regulations. It represents an important distinction from the civilian workforce. This military unique feature must be taken into account when examining patient safety and nurse staffing effectiveness. Therefore, civilian staffing and outcomes studies may not be representative of the military structure.

Historical Army Medical Department (AMEDD) personnel inventory data show a decline of 1,400 in the number of active duty Army Nurse Corps (ANC) officers from 1991 to 2001 (COL Carol Huff, personal communication, February 22, 2002). This decrease in the ANC was part of a much larger Department of Defense effort to reduce force structure, affecting all the Services, including the Army and the AMEDD. Recently the Air Force and Navy Nurse Corps have come under order to reduce in size.

Prior to the 1990s, staffing levels in military hospitals were somewhat resilient to fluctuations in the civilian nurse workforce because military nurses comprised the majority of the inpatient staff. This is no longer the case. Data from one Army MTF indicate a reversal in the RN workforce composition between 1996 and 2002. In 1996, the RN staff comprised 65% ANC officers and 35% civilians. These percentages were reversed by 2002 with an RN staff composition of 36% ANCs and 64% civilians. A transition in the LPN workforce also occurred during this time period. In 1996, the LPN staff comprised 64% Army personnel and 36% were civilians. By 2002, the split was more equal with 48% Army LPNs and 52% civilian LPNs. Similar changes are found when unlicensed personnel are considered. In total, military nursing personnel

accounted for a 70% majority of the workforce in 1996. Currently military personnel comprise only about 40% of the nursing workforce (Patrician et al., 2011). The collective effect of these shifts resulted in the requirement for new civilian nursing positions military medical centers, yet difficulty in filling the positions, especially in urban areas such as Washington, DC and Tacoma, WA.

Currently, civilian and military hospitals across the country are experiencing a respite from the recent and looming nursing shortages. This respite is attributed to the recent economic downturn, but is not expected to continue once the economy rebounds (Buerhaus, Staiger, & Auerbach, 2009). The increased average age of the RN workforce, upcoming planned retirements, and the aging population will all increase demands for RNs. According to Buerhaus et al. (2000), the U.S. will experience a 20% shortage in the number of nurses needed in our nation's health care system by the year 2020. This translates into a shortage of more than 400,000 RNs nationwide (Buerhaus, Staiger, & Auberbach, 2000). This is compounded by the recently documented nursing faculty shortage and nursing schools have been for the past five years, turning away qualified applicants because of insufficient faculty to teach them (Allen, 2008). The American Association of Colleges of Nursing (AACN, 2010) reports that nearly 55,000 qualified nursing student applicants are turned away annually because of the nursing faculty shortage. This alone will have a substantial impact on the pipeline for nurses to enter the military.

The deployment of active duty nurses and the subsequent activation of reserve nurses is another unique aspect of the military nursing workforce. Humanitarian and wartime missions require military nurses to leave their peacetime duty assignments in order to provide nursing services elsewhere. Reserve nurses are usually designated to replace deployed active duty nurses. Reserve nurses are trained to support the mission of their service (Army, Navy or Air Force) as part of their monthly and/or yearly drills, however, they may or may not be practicing nurses in their civilian jobs. Even those who are practicing nurses may not work in the specialty they are assigned to in their reserve unit—e.g. a reservist who is civilian pediatric nurse may be assigned to an adult medical nurse position. When deployments occur and reserve backfill is required, an orientation and train up period is required as reservist's transition for their new role in a new work environment. Consequently, depending on the size of the MTF, as many as a few hundred trained and experienced nurses may leave the patient's bedside one day and be replaced by nurses who are transitioning to new assignments the next day. To date, the impact of this military-unique aspect of nursing is not known.

Staffing Effectiveness and Patient Outcome Research

Evidence, albeit inconsistent in many cases, suggests that better staffing is associated with positive patient outcomes (Kane, Shamliyan, Mueller, Duval, & Wilt, 2007; Lang, Hodge, Olson, Romano, & Kravitz, 2004; Page, 2004). Higher nurse to patient ratios, higher proportions of registered nurses, and more total nursing care hours have been linked to lower patient mortality (Aiken, Clarke, Sloane, Sochalski, Silber, 2002; Aiken et al., 2001; Aiken, Smith, & Lake, 1994; Kane et al.; Lang, et al.;

Needleman, Buerhaus, Meattke, Stewart, & Zelevinsky, 2002), decreased length of stay and a lower likelihood of patient complications such as nosocomial infections and pressure ulcers (Kovner & Gergen, 1998; Blegen, Goode, & Reed, 1998; Lang et al; Needleman et al.).

Although research has amplified the importance of an adequate number and mix of nurses in providing high quality patient care, there are well known limitations of nurse staffing research, such as suitability of data sources for both staffing and outcome measures (Clarke & Donaldson, 2008). The available research is not easily translated into managing staffing or patient outcomes within facilities. For example, because a wide variety of factors must be considered in staffing decisions, there are no definitive formulas available to prescribe a certain number of nurses or skill level of nurses for a given unit. Therefore, there has been a growing national trend toward standardized measurements of nurse staffing and patient outcomes, promulgated by both the ANA and CalNOC, to create nursing services "scorecards" that enable nursing leaders to look within organizations as well as to compare their facility to other like organizations (Firth, Anderson, & Sewall, 2010). Currently, over 1,400 hospitals participate in the ANA's National Database of Nursing Quality Indicators (NDNQI; NDNQI, n.d.), and over 200 participate in the Collaborative Alliance for Nursing Outcomes (CalNOC; CALNOC, 2010).

Consequently, while findings are beginning to emerge regarding relationships between staffing and patient outcomes, a number of measurement and analytic issues remain to be resolved. Congruent with the American Nurses Association (ANA, 1995), the National Database for Nursing Quality Indicators (NDNQI, 2002), and the CALlNOC) (Brown, Donaldson, Aydin & Carlson, 2001), investigators for this proposed study believe the opportunity to advance measurement precision lies in our ability to capture nurse staffing and measures of clinical workload, along with patient care outcomes daily at the patient's bedside (Donaldson, Brown, Bolton, Aydin & Paul, 2001).

The MilNOD allowed military nurse leaders and military nurse researchers to trace and analyze daily variation in staffing with previously unrealized but essential precision and examine its effect on patient safety and outcomes. This approach is supported by Mitchell and Shortell (1997) who advocated addressing such questions at a smaller aggregate level—the unit instead of the hospital. Whitman et al. (2002) suggest that most hospital systems use either data from the department or the patient care unit level when reporting outcomes because it is theses operational groups who assume ultimate responsibility for these outcomes. Similarly, the Needleman group (2001) noted "we need to better understand the factors influencing both staffing levels and mix of personnel in hospitals" (p. 143).

Use of Database Performance Information for Quality Improvement

Currently U.S. health care industry efforts focus on identifying and standardizing nomenclature, integrating nursing data within patient safety and patient outcomes data, and developing databases and decision support systems for nursing. The term

database is defined as a collection of interrelated files with records organized and stored together in a computer system (American Nurses Association, 1994). Uses for databases include information retrieval, data sharing among users, statistical analysis, and knowledge building (Chowdhury, Linnarsson, Wallgren, Wallgren, Wigertz, 1990; Graves & Corcoran, 1988; Wu, Crosby, Ventura, & Finnick, 1994). Although the majority of existing health care data sources are rich repositories of administrative data, they are much weaker in respect to clinical data (Jennings & Staggers, 1997; Hierholzer, 1991). Hence, the availability of comprehensive and integrated clinical databases remains scarce (Jennings & Staggers, 1999).

The absences of high quality, retrievable data to guide cost cutting decisions feeds the cycle of targeting nursing, the largest personnel pool in inpatient facilities, when cost containment is necessary. Reductions in nurse staffing have reached crisis proportions nationally leading to attempts to legislate staffing ratios to preserve patient safety and quality care (Bolton, et al., 2001; Buerhaus & Needleman, 2000; Sovie & Jawad, 2001; Spetz, 2001). Concurrent with staffing reductions is the loss of individuals interested in nursing—both those currently in the profession who are either aging out or dissatisfied with their work environments, as well as a severely restricted inflow of nurses from the educational settings (Buerhaus, Staiger, & Auerbach, 2000). Reversing these trends depends, in part, on having better databases that have sufficient scientific integrity to allow for analysis of patient safety and quality care data. These databases must also contain nurse sensitive patient outcome and staffing data.

All accredited health care organizations use performance measures for quality improvement, but the degree and sophistication of use varies. Ideally, performance measures would be used to target quality-improvement initiatives, set goals, identify the root cause of problems, and monitor progress. The most useful measures were standardized, timely, stable, capable of trending, measured at the appropriate unit of analysis, affordable and cost effective, and relevant (Scanlon, Darby, Rolph & Doty, 2001). The MilNOD meets all six of these criteria as depicted in Table 1.

Table 1

Characteristics of the MilNOD

CRITERIA	EXPLANATION
Standardized	The MilNOD used an established fixed set of indicator definitions. These definitions are consistent with those used by the NDNQI and the CalNOC thus promoting standardization of nursing-specific data.
Timely	The MilNOD acknowledged the need to make decisions based on current data. The MilNOD provided current data decision-making via Quarterly reporting to nursing leaders at each participating MT
Stable & Capable of Trending	For military nursing, was not possible to assess whether patient safety and staffing effectiveness were improving or deteriorating. The MilNOD provided stable measures that were examined over time..
Appropriate Unit	The appropriate unit of analysis is a key element of whether measures

of Analysis	are actionable. MilNOD staffing data were collected every shift. All applicable indicators were reported to Chief Nurses quarterly.
Affordable and Cost Effective	The MilNOD was developed with careful consideration of affordable and cost effective measures. It standardized and improved data collection efforts at MTFs and provided participating MTFs with more sophisticated data analysis tools as well as comparison, target and benchmarking rates. Resources for MilNOD were centralized, and used throughout the study hospitals. Sharing of protocols and other documents were encouraged and highlighted in the newsletter, The MilNOD Messenger.
Relevant	Using measures that are specific to nursing, sensitive to changes in nursing care quality, and heavily supported in the civilian nursing community lend credibility to the relevance of the MilNOD. The MilNOD collected data that provided a better picture of the military nursing workforce.

Nurses' Work Environment

In hospitals, where nursing care remains the primary intervention, nurses serve as the patients' surveillance system (Aiken, Sochalski, & Lake, 1997). One aspect of inpatient care involves assessing patients for subtle changes that might indicate the onset of life-threatening complications. In order to appropriately intervene in such events, nurses must have the autonomy to put into practice what they know, have the necessary control over resources in order to intervene appropriately, and have positive relationships with physicians in order to mobilize those resources. The environment in which nurses practice is emerging as an important contextual indicator reflecting attributes of the hospital care setting in which nursing services are provided

Lake (2002) defines the nursing practice environment as the conditions under which nurses practice that may contribute to or detract from professional nursing practice. Research into the work environment of nurses has provided ample evidence that those with characteristics suggestive of professional nursing practice are associated with both better nurse staffing and better patient outcomes (Kazanjian, Green, Wong, & Reid, 2005). Favorable work environments for nurses have also been associated with low levels of nurse burnout, higher job satisfaction, less turnover and more positive patient outcomes, to include lower mortality and higher satisfaction (Aiken, Havens, & Sloane, 2000; Aiken & Sloane, 1997; Aiken, Sloane, Lake, Sochalski, & Weber, 1999; Aiken, Smith, & Lake, 1994; Brady-Schwartz, 2005; Friese, 2005; Kazanjian et al.).

Nurses working in Army hospitals may differ in how they perceive their work environments, career options, and decisions to terminate employment because of the particular nature of their employment as well as demographic peculiarities. Army nurses have responsibilities not only to maintain their clinical competency, but also to maintain military skills, such as weapons firing and physical fitness. As military officers, they are expected to advance in leadership education, skills and positions throughout

their careers. Many DoD civilian nurses are also officers in the Army Reserve, and have similar expectations. Army hospitals employ a mixture of RNs, licensed practical nurses, and nursing assistants who are military, civilian, or contract (agency) nurses. The highly structured, bureaucratic environments and demands of military life might hinder the flexibility and stability that characterize good work environments. Despite the possible burdens, there are great opportunities for advancement in military nursing. These include educational benefits, such as returning to school full time for advanced degrees -- with full pay, benefits, and tuition. The Army Nurse Corps (ANC) has more ethnic diversity and more males in its ranks than nursing in the civilian sector. In addition, the military rank structure might facilitate positive working relationships between nurses and physicians than in civilian settings (Patrician, Shang, & Lake, 2010).

Studies exploring the culture and dynamics of the nursing practice environment within the military health care system are dated, sparse, and inconsistent in their findings. Studies from the 1990s found poor nurse-physician communication and lack of autonomy in military nursing practice environments (Anderson, Maloney, Oliver, Brown, & Hardy, 1996; Maloney, Anderson, Gladd, Brown, & Hardy, 1996). However, Foley and colleagues (2002) found practice environments in two Army hospitals characterized by autonomy, control over practice, clinical expertise among the nursing staff, and collegiality with physicians.

The first system-wide investigation of the nursing practice environments within Army hospitals and their effect on nurses' job satisfaction, emotional exhaustion, intent to leave, and ratings of care quality found that the nursing practice environment had a substantial positive association with all outcomes (Patrician, Shang, & Lake, 2010). The largest effect was seen for emotional exhaustion. This study found that the professional practice environments within Army Medical Department hospitals were characterized as favorable overall, with nurses scoring on average somewhere between magnet and non-magnet hospitals on the Practice Environment Scale.

Although one study found a relationship between professional practice environments and nurse-reported patient safety climate (Armstrong & Laschinger, 2006), absent from this body of literature are investigations of the associations between the practice environment and patient safety outcomes, such as falls and medical errors, as well as studies on the moderating effects of the work environment on structural attributed (e.g., staffing) known to affect patient outcomes..

Summary

The research agenda for this multi-staged research program evolved from the beliefs and problem statements noted below.

Global Factors:

- Nursing care is a key factor in the outcomes of hospitalized patients.

- Additional factors affecting patient outcomes include severity of the patient's condition, other patient characteristics, services rendered by other disciplines, and the nurses' work environment.
- Systematic research addressing staffing effectiveness and patient outcomes has been conducted but suffers from several shortcomings in regard to the relationship of nursing care to patient outcomes (Blegen, Goode, & Reed, 1998).
- Hospital generated, direct care, staffing data are the "gold standard" for use when studying staffing effectiveness and patient safety in the Military Health System (MHS).

Nurse Staffing Factors:

- Military nursing leaders are concerned with staffing effectiveness and patient safety.
- Concerns about the adequacy of nurse staffing have heightened as the nurse shortage has compromised the ability of military hospitals to recruit and retain staff to meet their minimum staffing requirements.
- Having an adequate number of nurses at the bedside to care for patients is vital to ensure patient safety although there is little empirical evidence that can be used by leaders to determine nurse to patient staffing ratios (Bolton et al., 2001; Buerhaus & Needleman, 2000; Clarke & Donaldson, 2008; Kane, Shamlian, Mueller, Duval, & Wilt, 2007; Lang, Hodge, Olson, Romano, & Kravitz, 2004; Sovie & Jaward, 2001).

Nurse Executive Factors:

- Military nursing leaders have experienced an increased burden of data collection yet they lack the information distilled from such data to make meaningful decisions about staffing allocation
- There is lack of outcome measurement and reporting systems in the MHS especially those with outcomes sensitive to nursing care.
- Because nurse-sensitive military outcome data reporting systems do not exist, each request for nursing care structure and patient outcome data requires an individual data collection effort.
- The quality of data collected from these efforts is often lacking. High quality data are needed for decision making.
- Across the MHS nursing leaders are grappling with similar issues related to collecting, analyzing and interpreting data to be used for decision making.
- It is critical for military nurses to standardize data collection processes to decrease duplication, increase benchmarking, and maximize uniformity.

MilNOD Opportunities and Challenges:

The MilNOD was created to combine the 'real world' of hospital data collection and the data needs of nursing leaders with the scientific integrity of a research database that meets the requirements for scientific inquiry (Brown, Donaldson, Aydin, & Carlson, 2001).

- This database relied on input of data at the hospital level; therefore, processes had to be emplaced to ensure data integrity. From the perspective of the hospital, these processes needed to be easy to understand and implement with limited hospital resources. From the perspective of the researcher, processes were standardized and implemented as consistently as possible across institutions and over time.
- Database quality is vital. Efforts were applied to maximize data quality before the data were used for research or decision-making.
- Populating a database for research purposes alone did not entice nursing leaders to participate in a nursing outcomes database. Nursing leaders and hospital commanders saw a benefit from participating. Reports of hospital performance on each indicator as well as comparison data from other participating hospitals were a motivating benefit to nursing leaders.
- A standardized nursing outcomes database was created to meet the above mentioned requirements and was used at MTFs of all sizes and by all services to benefit military nursing leaders and their MTFs as well as provide valuable data to address important military nursing research questions.

The MilNOD was developed based on these beliefs and tenets. Although many of the assertions outlined above are echoed in the civilian nursing community, important differences between the provision of health care in civilian institutions and the MHS necessitate a focused inquiry into staffing effectiveness and patient safety in military hospitals. For example, specific to nursing, in the MHS:

- Nurse staffing models included *fewer* RNs and *more* LPNs, medics, corpsman and nursing assistants due to military readiness and force structure requirements peculiar to the military mission.
- Military activities required nursing personnel to be away from the patient care unit to which they are assigned (from 1 hour to many months).
- Reserve military nurses were used to replace deployed active duty staff nurses.
- Staff members have dual roles as both nurse and soldier.
- One half to two-thirds of the military nursing staff geographically rotate from MTF to MTF every 2 to 5 years; additionally, civilian nurses married to military personnel also rotate frequently.
- More military RNs have bachelors, masters and doctoral degrees than their civilian counterparts (Patrician, Shang, & Lake, 2010; US Department of Health and Human Services [DHHS], 2010)
- More nurses associated with the military have advanced and specialty training (i.e. ICU, OR, leadership) as compared to their civilian counterparts (DHHS, 2010).
- More new graduate nurses take care of patients at the bedside.
- Nurses' pay structures and career ladders in military facilities may vary greatly from those in the local community.
- Due to the requirement for frequent geographic relocation many military patients and families lack family support systems.
- Most patients seen in MTFs have full health insurance coverage, provided by the MHS.

In addition, MHS data are not typically available as large public datasets for use in studies comparing nursing indicators to patient outcomes. The generalizability of the findings from past nurse staffing and patient safety studies conducted using civilian data to the MHS is questionable.

It has been noted that organizations measure what they value (Eccles, 1991). For military and civilian health care organizations, it would be more appropriate to state that measurements are derived from data that are currently available (Jennings & Staggers, 1997) rather than what ought to be measured. Consequently, the reliance on individual MTF data collection efforts and existing MHS administrative databases to supply proxy measures of clinical phenomena yield gross estimates at best, as well as distortions and most often a complete inability to address clinical issues. When hospital Commanders ask nursing leaders to defend the costs for the largest personnel pool in the inpatient facility, there is often insufficient evidence to support a response.

Individual MTF outcome data sets are limited to descriptive reports because patient unusual occurrences are often uncommon events. The infrequent occurrence of certain events would require a large number of months or years to accumulate enough power to test a hypothesis regarding the relationship of staffing to negative patient outcomes. From the administrative perspective, few facilities report data that can be used for inter-facility comparison. This is because many reported indicator values usually lack definition specificity.

Scope of the Study

This study represented the fourth in a program of research designed to collect reliable and valid data on nursing structural indicators, nurse-sensitive patient outcome indicators, and nursing outcomes, as well as to explore the association between nursing structural indicators, specific explanatory variables, patient and nurse outcomes, and the context of nursing care (i.e., the work environment). The first phase of this research program determined that nurse-sensitive indicator data proposed by the American Nurses Association could be successfully collected in one Army Medical Center (Hildreth, Jennings, Loan, DePaul, & Brosch, 1997; Jennings, Loan, DePaul, Brosch, & Hildreth, 2001). The second in this series of studies, the Army Nursing Outcomes Database, demonstrated that nursing indicator data and patient level outcomes could be 1) standardized in terms of definitions; 2) collected in two Army Medical Centers; and 3) used for decision making by nursing administration. Using California Nursing Outcomes Classification (CalNOC) data as a benchmark, both MTFs were able to compare their staffing, skill mix, and outcomes data to each other and to CalNOC (Brosch & Loan, 2001).

The third study in this program of research, Establishing a Military Nursing Outcomes Database (MilNOD III), successfully established that this type of intense data collection could occur over a longer time period (180 days as opposed to the previous study's 60 days) and could incorporate small and medium sized hospitals from all three services.

Additionally, definitions of key indicators were standardized across all participating MTFs and the validity and reliability of the data collected were documented. The current study, Military Nursing Outcomes Database: Analysis and Expansion (MilNOD IV), represents a shift in research efforts from creating a high quality, reliable and valid data collection mechanism and associated database to examining aspects of structure, process and outcomes specific to nursing.

Specific Aims of the Study

The study began with the following two specific aims:

1. Expand the number of participating MilNOD military treatment facilities (MTF) from seven to thirteen. These would include the following MTFs representing all three branches of the military (Army, Navy and Air Force)–* indicates new sites to be added to MilNOD IV.

    a. Army MTFs - *Bassett Army Community Hospital, *Brooke Army Medical Center, DeWitt Army Community Hospital, Madigan Army Medical Center, Walter Reed Army Medical Center, Womack Army Medical Center
    b. Navy MTFs – *National Naval Medical Center Bethesda, Naval Hospital Bremerton, Naval Hospital Oak Harbor, *Naval Medical Center San Diego
    c. Air Force MTFs - *Elmendorf Air Force Base Hospital, Malcolm Grow Medical Center, *Wilford Hall Medical Center

These new sites were added to allow further testing to determine whether or not the MilNOD could be replicated and deployed across additional military treatment facilities and what utility could be corporately realized from the accumulation of this rich source of indicator and outcomes data across the system.

2. Analyze the data collected during MilNOD III and IV. This analysis would examine the relationships between nursing structural indicators, contextual features of the work environment, explanatory patient level variables, and nurse and patient outcome indicators.

At the time the study was funded, the research team proposed several additional indicator variables, and needed to test their collection and use, therefore aim #2 was purposely vague.

As the study progressed, however, the specific aims were further refined and separated into two major categories: 1) expansion (one aim) and 2) analysis (ten aims) as follows.

Expansion

The specific aim regarding the expansion of the study was modified from fourteen total sites to thirteen sites representing all three branches of the military (Army, Navy and Air Force). One particular site that was targeted for inclusion, the Air Force Academy hospital, was ultimately excluded because of IRB and patient population concerns.

Analysis

The analysis was further refined to encompass a total of ten specific aims:

1. For each unit type (medical, surgical, ICU, stepdown) and controlling for hospital size (small, large), do structural variables affect outcomes at the shift level?

2. Explore the effects of patient turnover and census on the relationship between structural variables and outcomes.

3. Over time have MilNOD participating facilities decreased their use of restraints and adverse events?

4. Controlling for unit type, are structural variables measured on day of observed restraint assessment associated with restraint prevalence?

5. Controlling for unit type, are structural variables associated with pressure ulcer prevalence (hospital-acquired stage II and greater)?

6. Controlling for patient risk (Braden score, BUN, Creatinine, Albumin), determine which units have a greater incidence of hospital-acquired pressure ulcers stage II or greater.

7. What variables, if any, predict good versus poor performance related to pressure ulcer prevention? Good performance is indicated by having high risk and low pressure ulcer prevalence. Poor performance is defined as low risk and high pressure ulcer prevalence.

8. Which variables predict patient's report of satisfaction (overall and various aspects)?

9. Does staffing and staff category impact how nursing personnel respond when surveyed about the work environment and nursing job satisfaction?

10. Does patient turnover contribute to nurse dissatisfaction?

Furthermore, the analysis was broadened to include not only the data from MilNOD III but the data from MilNOD IV as well. The additional analytic aims and data inclusion plan was approved by TSNRP in 2006.

Research Plan

Framework

The MilNOD project was guided by Donabedian's (1966) triad of structure, process, and outcome; the Quality Health Outcomes Model that included feedback among patients, systems of care, and interventions (Mitchell, Ferketich, & Jennings, 1998); and the work of Aiken and colleagues (1997; 2008) that incorporates the nursing practice environment as a contextual variable. MilNOD researchers theorize that structural factors independently and in combination with contextual factors affect patient and nurse outcomes.

Most of the indicators (Table 2) and procedures used in MilNOD are patterned after the ANA Safety and Quality Initiative (ANA, 1995; 1996a; 1996b) and used in the NDNQI. However, the framework for MilNOD is specifically patterned after CALNOC (Brown, Donaldson, Aydin & Carlson, 2001).

Table 2

MilNOD Indicators

Type	Indicator
Structural	Nursing Care Hours[ab]
	Nursing Staff Mix[ab]
	Nursing Staff Education & Experience[b]
Contextual	Nursing Work Environment
Explanatory	Patient turnover (admissions, discharges, transfers)
	Patient acuity
Outcome	
Patient	Pressure Ulcer Prevalence[ab]
	Restraint Use Prevalence[b]
	Patient Falls[b]
	Patient Satisfaction with Care[ab]
	Patient Satisfaction with Planning for Needs After Discharge[b]
	Patient Satisfaction with Pain Management[ab]
	Patient Satisfaction with Education[ab]
	Medication Administration Errors[c]
Nurse	Nursing Job Satisfaction[ab]
	Nursing Needlestick Injuries[c]

[a]Matches the NDNQI definition. [b]Congruence with corresponding CalNOC indicator. [c]Developed during MilNOD III study.

Design

Expansion

For the expansion, the research team replicated the data collection methods from MilNOD III and applied the existing methodology, to include data reliability and validity assessments, to the seven new MilNOD IV sites.

Analysis

The data used for the analysis section of this study consists of prospectively collected data to include nurse staffing, education, experience, and work environment data; nursing job satisfaction; and patient satisfaction as well as retrospectively collected adverse event reports. The data sources are listed in Table 3.

Table 3

Data Sources

Data Source	Empirical Indicator	Variables
Daily staffing worksheets	Institution-specific	Nursing staff hours Nursing skill mix Patient turnover Patient acuity (daily) Patient census
Prevalence survey	Prevalence documentation form	Pressure ulcer prevalence Restraint use prevalence
Institutional incident reports	Incident reports, institution-specific	Medication administration error Nursing staff needlestick injury Patient falls
Patient survey	Patient Satisfaction with Nursing Care Questionnaire	Patient satisfaction with: Nursing care Planning for needs after discharge Pain management Education
Nurse survey	Single item measure Education and Experience Survey Practice Environment Scale of the Nursing Work Index	Nursing job satisfaction Nursing staff education and experience Nursing work environment

Settings

Data collection occurred at 6 small (≤50 beds) and 7 large (> 50 beds) military hospitals located throughout the United States. There was one medium sized hospital (51-99 beds) but its characteristics mirrored those of the larger facilities (i.e., designated medical center, teaching hospital) so it was subsumed into the large hospital category. Types of units included in the study were medical, surgical, mixed medical/surgical, stepdown and critical care units.

Units of Analysis

A variety of units of measurement and analysis were used in this study. These include:

Shift-Level
Nursing care hours for each skill level (RN, LNP, Unlicensed personnel) and category (military, civilian, contract, reservist); nursing skill mix; nursing category mix; patient admissions, discharges, and transfers data were collected at the shift-level by unit. Patient acuity and census were collected at least daily. The dataset is comprised of 227,253 shifts of staffing, census, and acuity data.

Patient falls (N=949) and nurse medication administration errors (N=1,395) were obtained from institutional adverse occurrence reports and nurse needlestick injuries (N=80) were obtained from occupational health or risk management reports. These incidents were then assigned to the unit, date, and shift of occurrence.

Patient-Level
Pressure ulcer, restraint use and patient satisfaction with nursing care indicators were assessed at the individual patient level. Patient satisfaction data from 1,721 patients are included in the sample. In addition, approximately 1,684 patients took part in prevalence surveys for pressure ulcers and restraint use.

Nurse-Level
Nurse job satisfaction, nursing staff education and experience, and the nursing work environment were assessed at the individual nurse level. This sample includes 1,042 RNs and 544 LPNs and unlicensed assistive personnel who worked in medical surgical, critical care, or step-down units in the thirteen participating MilNOD hospitals.

Variables and Measures.

Structural Indicators

Nursing care hours. Nursing care hours (NCH) were defined as the productive hours worked by the inpatient nursing staff who have direct patient care responsibilities/assignments on a defined unit and were included in the workload prediction system based on patient volume, patient acuity and/or nursing workload

(CalNOC, 2001). Direct patient care assignments were defined in terms of those RNs, LPNs or unlicensed assistive personnel who provided direct care for at least 50% of their shift. When making the decision about whether a staff member should be counted as a direct patient care provider was difficult, coders were to ask nursing managers "would the nurse be replaced if he or she called in sick?" If the answer was "yes" their hours were included. Other paid hours for any indirect care and/or non-productive time (sick time, vacation, and education leave), committee time, or military requirements (unless the time is a very short period of time away from the unit and those hours were not replaced with another direct patient care giver's hours) were NOT included. Nursing care hours were collected in several categories:

- RN Care Hours
- LPN Care Hours
- Other Care Hours (unlicensed providers)
- Total Nursing Care Hours - Calculated within the MilNOD database from the above indicators. Defined as the total number of productive hours worked by all nursing staff with direct patient care responsibilities (RN, LPN, aides, other direct care providers included in the staffing matrix). These hours were documented each shift.

Nursing Skill Mix. Nursing skill mix was defined as the relative proportion of total nursing care hours delivered by unique categories of nursing providers.

- RN Skill Mix - The proportion of RN nursing care hours compared to total nursing care hours.
- LPN Skill Mix - The proportion of LPN nursing care hours compared to total nursing care hours.
- Other Skill Mix (unlicensed provider mix) - The proportion of all unlicensed nursing care hours compared to total nursing care hours. Nursing assistants were the most predominant care providers in this category. Other providers such as telemetry technicians on a cardiac step-down unit and Air Force and Navy corpsmen were annotated in this category.

Nursing category mix. Nursing personnel work hours were further divided by category of provider, i.e., active military, GS civilian, contractor, and military reservist. These categories were calculated as proportions similar to the skill mix as indicated above.

Nursing Education and Experience. Nursing personnel included RNs, LPNs and unlicensed personnel. This information provided an additional dimension in the interpretation of nurse staffing information and was collected from individual nurses using an adaptation of the CalNOC Education and Experience Questionnaire. Components included:

- Demographic Information
- Highest education level Highest level of nursing education
- Number of years of nursing experience
- Number of years of experience in the current hospital

- Number of years of experience taking care of the types of patient encountered in currently assigned unit.
- Certifications

Patient Outcome Indicators

Pressure Ulcer Prevalence. This was defined as the proportion of all patients examined during a one-day prevalence survey with stage I, II, III, IV pressure ulcers. All inpatients admitted prior to midnight of the prevalence survey day were included. This included those patients admitted with pressure ulcers. Prevalence is expressed as a percentage, in relation to the total number of patients surveyed (# patients with ulcers/ # patients in study). Note that prevalence is NOT the number of ulcers discovered (some patients have multiple ulcers) (CalNOC, 2001). A copy of the tool used to gather the survey data is included in this report. Hospital acquired pressure ulcers prevalence is defined as the proportion of all patients examined with a Stage II or greater pressure ulcer that was not documented on admission.

Restraint Use Prevalence. This was defined as the proportion of all patients observed (on the day of the pressure ulcer prevalence study) who had one or more restraints in place. Prevalence is expressed as a percent, in relation to the total number of patients surveyed (# patients with restraints/# patients in study). The definition of a restraint used was “any method of physically restricting a person’s freedom of movement, physical activity, or normal access to his or her body either part of an approved protocol, or as indicated by individual order” (CalNOC, 2001). This included 4 bed rails in the up position. A copy of the tool used to gather the survey data is included with this report.

Patient Falls. A patient fall is defined as “a patient’s unplanned descent to the hospital floor” (CalNOC, 2001). Falls data, extracted from MTF unusual occurrence reports, included the unit on which the fall occurred, the time of day of the fall, the presence of and level of injury, circumstances (observed, assisted, restrained at the time of the fall), type of fall (accidental, unanticipated physiologic, anticipated physiologic fall or unknown; Morse, 1991) and presence or absence of falls prevention protocol initiation. A patient fall with injury was treated as a separate outcome variable and was defined as a fall with ANY injury to the patient as documented on the hospital unusual occurrence report.

Medication Administration Error. A medication administration error is defined as “a deviation from the physician’s medication order as written on the patient’s chart” (Allan & Barker, 1990, p.555) committed by a nurse. Medication error data were extracted from institutional incident reports. Any “near miss” errors, intercepted and corrected before reaching the patient, were not counted as an actual medication administration error. Data that were collected include the unit where the error occurred, date, time, type of medication error, and presence and level of injury.

Patient Satisfaction with Nursing Care. The Patient Satisfaction with Nursing Care Quality (PSNQ; Jacox, Bausell, & Merenholtz, 1997) survey was used to measure patient satisfaction with aspects of hospital care. The CalNOC-developed definitions of four specific aspects of patient satisfaction derived from the ANA Nursing Quality Indicators were used in this study. However, CalNOC used Yes/No responses which we deemed not appropriate to capture sufficient variability. To remain consistent with CalNOC and NDNQI patient satisfaction with nursing care measures, items identical to those included on the CalNOC patient satisfaction survey were pulled from the PSNQ instrument. In addition, we also report the orginal PSNQ subscales.

- Patient Satisfaction with Pain Management: A measure of patient perception of the hospital experience related to satisfaction with pain management.
- Patient Satisfaction with Patient Education: A measure of patient perception of the hospital experience related to satisfaction with patient education.
- Patient Satisfaction with Planning for Needs after Discharge: A measure of patient perception of the hospital experience related to satisfaction with planning for needs after discharge.
- Patient Satisfaction with Overall Care: A measure of patient perception of the hospital experience related to satisfaction with overall care.

Nursing Staff Outcome Indicators

Nursing Job Satisfaction. Nursing job satisfaction is defined as the degree to which a nurse rates his or her global contentment with her job. Job satisfaction was measured in this study by a single item-measure of overall job satisfaction which was found to be highly correlated with respondent's global satisfaction scores in other studies (Patrician, 2004) The item reads: Overall, how satisfied are you with your current job? The response choices are: 5 = Very Satisfied, 4 = Somewhat Satisfied, 3 = Neutral, 2 = Somewhat Dissatisfied, and 1 = Very Dissatisfied.

Nursing Staff Needlestick Injury. A nursing staff needlestick injury is defined as "a puncture with a needle or sharp instrument that is contaminated with blood" (Clarke, Sloan, & Aiken, 2002). Needlestick injuries were obtained from the occupational health clinic or its equivalent of the participating MTF. Data on needlestick injuries included time, date, unit, personnel, type, device, and whether or not the device was contaminated.

Explanatory Variables

*Patient Turnover***.** Patient turnover is defined as the number of admissions, discharges and transfers (ADT) for the past shift divided by the unit patient census. It is also referred to as the ADT Index. Census is a static number–it does not reflect the considerable work generated by admitting patients to the unit, discharging patients from the unit, or transferring to or from another unit (Fralic, 2000). The ADT Index is a pragmatic and easily understood way to reflect the stress and strain on nursing staff that is not always reflected in the census. The census by itself is far less informative than the census viewed in combination with the ADT index. A high census with a low ADT

Index reflects a more stable workload than a high census in combination with a high ADT Index. Conversely, a low census with a high ADT Index, especially when the high index is sustained reflecting a high turnover of patients, can reflect situations in which staff are exposed to unrelenting stress, a condition that may set the stage for compromising the quality of care. Every shift, the staff were expected to enter these data into the database.

Patient Acuity. Patient acuity is defined as the severity of a patient's illness and reflects nursing care requirements of patients. The Workload Management System for Nursing (WMSN) is the acuity system that has been used by all three services since the 1980s (WMSN, n.d.) Developed from time and motion studies, it relies on a very detailed checklist of nursing tasks. Once a checklist is completed and points are totaled, a number is assigned from I to VI to indicate the nursing care requirements for a particular patient. The unit's total patient acuity has been converted into required nursing care hours and has been used as a staffing projection system for many years. The staffing predictive capability of the WMSN has been questioned, and therefore required nursing care hours were not used in this study. However, the individual acuity measure, specifically the average unit acuity was thought to be useful for this study. Nurses were asked to enter into their unit's database the number of patients within each acuity category and an average acuity measure was tabulated. This was generally done once a day.

Contextual variable: Nursing work environment. The nursing work environment was defined as "conditions which facilitate or detract from the ability of nurses to carry out their work" (Lake, 2002). Work environment was measured with t he Practice Environment Scale of the Nursing Work Index (PES-NWI; Lake, 2002). On the PES-NWI, nurses indicated the extent to which certain work environment attributes were present in their current job. Items comprising the PES-NWI scales are ranked qualitatively with four category responses ranging from one (strongly disagree) to four (strongly agree) with a midpoint of 2.5. From the PES-NWI, five subscales were calculated: Nurse Participation in Hospital Affairs; Nursing Foundations for Quality of Care; Nurse Manager Ability, Leadership and Support; Staffing and Resource Adequacy; and Collegial Nurse-Physician Relations. A Professional Practice Composite Score was also calculated to represent an overall measure of the work environment. Reliability and validity of the instrument and its subscales have been published (Lake, 2002).

Data Collection Methods

Data collection overview

Participation in this multi-site study was solicited by letters of invitation directed at Chief Nursing Officers (CNOs) at the proposed hospitals. Following IRB approval and hospital enrollment, core MilNOD team members visited each site to introduce the study to major stakeholders, including the Chief Nurse, section supervisors/division heads, and unit level nurse managers. Research assistants (RAs) or site coordinators (SCs)

were situated either directly at the facility (for large facilities) or within geographic clusters of hospitals (for small facilities) to serve as facilitators for data collection. Each SC/RA received a set of orientation materials in addition to the Codebook and was trained extensively by core team members. SC/RAs then walked individual site staff through the process of data collection and data submission initially and whenever site personnel were replaced. A 30-day run-in period to ensure data accuracy and validity preceded data collection at each site. Feedback on accuracy and completeness of data was provided on a continual basis.

Instructions for all survey processes were standardized with oversight provided by COL (ret) Bingham at Brooke Army Medical Center and survey development and distribution provided by Mr. Jim Williams (at Walter Reed Army Medical Center). Training materials were made available to each site as needed.

Data collection schedule

Timelines were provided to site coordinators were used to assist them with organization and coordination of study activities. Surveys were conducted in a designated quarter. Every attempt was made to have all facilities conduct the survey as scheduled so that a report of findings from the survey could include comparisons from other like-size hospitals. Table 4 highlights the data collection schedule.

Table 4

Data Collection Schedule

Quarter of FY	Months	Data Collected
1st	October-December	Nursing Survey
2nd	January-March	Pressure Ulcer/Restraint Prevalence (a)
3rd	April-June	Patient Survey
4th	July-September	Pressure Ulcer/Restraint Prevalence (b)
Ongoing		Monthly transmittal of shift level data approximately 8 weeks after the end of a quarter; quarterly transmission of adverse event data

Structural Indicators

Staffing measures were captured for each shift using the traditional 8-hour shift categories (day (0700-1459), evening (1500-2259), and night (2300-0659). Every shift, the nurse manager, or designee, reported the hours worked by each of the following provider types: RNs, LPNs, and unlicensed personnel, which included NAs, corpsmen, and telemetry technicians.

Reflecting the unique configuration of military hospital staffing, each provider type was further differentiated by the following categories: active duty military, Department of Defense civilian, military reservist, or contract/agency. The reservist category was comprised of nurses who were activated in support of Operation Enduring Freedom/Operation Iraqi Freedom and often times replaced deployed military nurses. For those staff who worked 12 hour shifts, staff work hours were split into the two time frames that encompassed the shift, typically with four hours on one shift and eight on the other. One hospital in particular had 14 different shift configurations. Instruction sheets with conversions assisted data entry personnel in transforming the various shifts into 8-hour increments.

The unit managers or designated data entry personnel were instructed not to count hours providers spent away from the unit, i.e., time spent in a class or as borrowed manpower "floated" to another unit in the hospital. Similarly, hours worked by nursing personnel on loan to a specific unit or those providing consultation on that unit such as a wound care nurse, were counted as present on that unit.

From the data on patient care hours worked, the researchers calculated percentages for provider type (skill mix), i.e., RN, LPN, NA and provider category, i.e., civilian, military, reservist, contract. Total nursing care hours per patient shift was a sum total of all hours worked by all nursing providers for that shift divided by number of patients on the shift. The remaining structural variables, to include nursing staff education and experience, were collected via survey and methods used are described under "*Survey"* below.

Explanatory Variables

Explanatory variables include patient census, average patient acuity (based upon a standard acuity system used by the military), and patient turnover. Patient census was captured each shift; however, when any given shift census was missing, the daily census for that day was used. Patient acuity data was captured on the day shift. Because the patient acuity system was designed to be a prospective acuity system, all three shifts on a given day were assigned the same acuity values captured for that day. Admissions, discharges and transfers were captured each shift and used to calculate the ADT Index as previously described.

Outcome Indicators

A separate database was created and maintained for adverse events. Each month Performance Improvement (PI) data (institutional incident reports), for the monthly period starting three months prior to the month of collection, were reviewed and data were extracted. A three month lag time was used to ensure that all incident reports traversed the system and were available in the PI office. Information that was collected by the "events" database included the date and time of the incident, whether or not the patient was harmed and the level of harm, types of falls (anticipated, unanticipated,

accidental), types of medication administration errors, and whether a nurse sustained a needlestick injury with a contaminated needle.

In order to analyze the associations between staffing and the occurrence of adverse events, the "events" dataset was merged with the shift level staffing and census database. Medication administration errors (ME), patient falls, falls with injury, and needlestick injuries (NS) were coded as either 0 or 1, indicating the absence or presence, respectively, of the particular event each shift. In addition, a shift composite outcome was created, defined as the presence of any adverse occurrence (AO) out of those events listed above. Inter-rater reliability scenarios were developed to assess validity and reliability of falls and medication error reporting.

Prevalence Studies

Pressure ulcer and restraint use prevalence studies were conducted at each of the participating sites by onsite staff and members of the study team using direct patient observation and medical record review. MilNOD study team members and local wound nursing experts taught on-site nurses how to grade pressure ulcers and evaluate restraint use. On the day of each prevalence study, all participating adult acute care inpatients admitted to the MTF prior to midnight the night before received a full body skin assessment and evaluation of restraint use. Inter-rater reliability was conducted with pressure ulcer and restraint use prevalence surveys. A member of the MilNOD team was present to assist with training and conducting the PU survey initially at each site and for subsequent surveys upon request (usually Dr. McCarthy and/or LTC Armstrong). Retrospective data related to pressure ulcers and restraint use were collected from the inpatient records of participating patients. During the prevalence study, all skin and restraint evaluations were performed by at least two trained nurses to further ensure agreement and inter-rater reliability. Table 5 details the pressure ulcer and restraint use survey dates and level of participation by MTF. Each patient assessed for pressure ulcers was also assessed for restraint use.

Table 5

Pressure Ulcer and Restraint Use Prevalence Study Assessment Rates by Facility and Year

Facility	Date	# Eligible patients	# Patients Assessed	Proportion Assessed
101	19 Aug 2003	165	125	76%
	9 Jun 2004	140	115	82%
	Jan 2005	151*	113	75%*
	Jan 2006	130*	100	77%*
102	25 Sep 2003	68	67	99%
	27 Jul 2004	89	83	93%
	23 Feb 2005	102	91	89%
	Oct 2005	76*	65	86%*

	Mar 2006	80*	79	99%*
103	27 Apr 2005	156	136	87%
	7 Jun 2006	147*	147	100%*
104	17 Nov 2005	104	104	100%
105	Apr 2006	77*	77	100%*
106	Sep 2005	---	75	---
	Mar 2006	87*	69	79%*
501	11 Dec 2003	41	39	95%
	7 Jun 2004	39	30	77%
	Apr 2005	42*	42	100%*
	Feb 2006	39*	35	90%*
502	22 Sep 2003	26	24	92%
	7 Jun 2004	17	12	71%
	Jan 2005	12*	12	100%*
	Feb 2006	12*	8	67%*
503	Mar 2006	5*	4	80%*
901	17 Dec 2003	16	13	81%
	Aug 2004	1	1	100%
	Jan 2005	4	3	75%
903	4 Jun 2004	7	4	57%
904	4 Jun 2004	11*	11	100%*
	TOTALS	1,844	1,684	Ave 91%

* Estimated census from average daily census of the month the PU Prevalence study was conducted. There were no census data for Facility 106 in September 2005.

Nursing Survey

All MTFs administered the Nursing Personnel Education, Experience, and Certification Survey, the Revised Nursing Work Index Survey, and a single item nurse satisfaction measure to the nursing staff on participating units at approximately twelve month intervals using a modified Dillman (2007) method. The Dillman method recommends an advance letter to let potential participants know that a survey will soon be mailed to them. This step was modified slightly by announcing the survey to nursing staff through the MTF email system. Additionally, the nurse surveys were not mailed. Instead surveys with an attached stamped return envelope were placed in each nurse's mailbox on their unit. Nurses were asked to fill out the survey during their duty time and instructed to mail their completed survey in the return-addressed stamped envelope to the study PO Box in Laurel, MD. Also as advocated by Dillman (2007), a post card and email message were sent to all nurses approximately two weeks after the first survey distribution. This follow-up procedure served to thank people who participated and encouraged those who had not yet returned their survey to do so. Finally, two weeks after the post card was distributed, a second distribution of surveys was made to all non-responders from the first distribution and the follow-up postcard. Return envelopes on all surveys were coded to allow survey central research team members to determine which nurses required a second survey.

Table 6

Nurse Survey Response Rates by Facility and Year

Facility	Year	RN Surveys			LPN/NA Surveys		
		Sent	Return	Response Rate	Sent	Return	Response Rate
101	2003	212	79	37.3%	200	50	25.0%
	2004	219	77	35.2%	186	42	22.6%
	2005/6	219	68	31.1%	166	30	18.1%
102	2003	158	66	41.8%	150	39	26.0%
	2004	165	61	37.0%	127	39	30.7%
	2005/6	139	66	47.5%	92	44	47.8%
103	2004	218	98	45.0%	117	73	62.4%
	2005/6	270	105	38.8%	163	46	28.2%
104	2005/6	244	100	40.9%	98	20	20.4%
105	2005/6	124	32	25.8%	73	8	10.9%
106	2005/6	144	66	45.8%	126	42	33.3%
501	2003	150	38	25.3%	100	15	15.0%
	2004	55	28	50.9%	16	7	43.8%
	2005/6	59	26	44.1%	38	18	47.4%
502	2003	60	37	61.7%	75	12	16.0%
	2004	44	21	47.7%	48	9	18.8%
	2005/6	27	11	40.7%	27	5	18.5%
503	2005/6	23	20	87.0%	33	21	63.6%
901	2003	30	8	26.7%	35	7	20.0%
	2004	17	8	47.1%	18	6	33.3%
	2005/6	17	4	23.5%	14	5	35.7%
902	2005/6	16	10	62.5%	15	3	20.0%
903	2004	16	10	62.5%	4	1	25.0%
	2005/6	10	3	30.0%	8	2	25.0%
	TOTALS	2,636	1042	39.5%	1,929	544	28.2%

Patient satisfaction survey

Patient satisfaction surveys were conducted using the process described above with a few modifications. All patients discharged to home from participating units at a participating MTF after 1 May 2004 were mailed a patient satisfaction survey at specifically designated times, according to the predetermined survey schedule. On-site coordinators sent the names of discharged patients and their mailing addresses to the WRAMC research team within one week of discharge. At two facilities it was required that the RA travel to the MTF and prepare the survey packets on site because the IRB

Committee at those facilities did not want patient names to be released from the MTF. For all other facilities the survey central office mailed surveys to patients two weeks after their discharge. Patients received a survey with a return-addressed stamped envelope. They were instructed to return the survey via U.S. Postal Service in the envelope provided. Post cards and a second survey were mailed to these patients as previously described for the nursing surveys. The number of patients surveyed and the response rate is provided in Table 7.

Table 7

Patient Satisfaction Survey Response Rates by Facility and Year

Facility	Date	# Patients Surveyed	# Patients Responded	Response Rate
101	2004	280	143	51.0%
	2005	349	144	41.2%
	2006	183	84	45.9%
102	2004	150	108	72.0%
	2005	200	147	73.5%
	2006	195	133	68.2%
103	2005	200	126	63.0%
	2006	180	122	67.8&
105	2006	190	130	68.4%
106	2006	183	117	63.9%
501	2005	181	94	51.9%
	2006	163	95	58.3%
502	2004	150	51	34.0%
	2005	37	18	48.6%
	2006	38	17	44.7%
503	2006	39	15	38.5%
901	2004	115	43	37.4%
	2005	40	25	62.5%
	2006	48	24	50.0%
902	2006	46	18	39.1%
903	2005	50	25	50.0%
	2006	36	16	44.4%
904	2006	53	26	49.1%
	TOTALS	3,106	1,721	55.4%

The research team members responsible for survey administration used Teleform® software to prepare the surveys, scan completed surveys, and enter data that were exported to a designated file into SPSS. The survey forms used a combination of numeric constrained print fields and choice fields and participants darkened selected responses. The form design defined how the data were validated and stored in the database, including variable types and coding for single or multiple responses. When forms were scanned into the software, the Teleform® Reader

automatically evaluated the record and either held it for verification or interpreted the characters, darkened bubbles, and other markings. This verification procedure required meticulous attention to detail, including matching data received with transmission information from the MTFs to ensure no data were lost in the mail. The verified Excel data files were then checked for errors and imported into the MilNOD data bank.

Data Preparation

Data Quality Assessments. Preparation for data analysis, including data cleaning, identification of outliers, and data integrity checks, was originally accomplished at MAMC. Throughout the study, the research staff at MAMC continually cleaned the data and assessed for out of range elements. Apparent errors and out of range entries were verified by phone call with on site Research Assistants and/or directly with unit nurse managers. Quarterly reports were another opportunity to conduct data quality assessments as nurse leaders at the sites were able to visualize their data and unusual data elements were brought to the attention of the MAMC research staff. In an effort to continually clean the database, staff were allowed to change the data entered in the database if it could be verified. For example, if a unit appeared to have too many falls, the RA could go back to source data to track down the error and it was reconciled in the database. Any requested changes o the database that were not based on evidence were not made.

The quarterly reports also contained missing data reports to alert the nurse leaders to the absence of data, and thresholds were set in reporting, such that if greater that 70% of the data were missing on a variable, a report would not be generated for that data element.

Analytic Database Preparation. Merging of the data for analysis was conducted at MAMC and also at the University of Alabama. For the first five aims of the analysis, the shift level dataset was constructed at MAMC, and had undergone further cleaning and verifying between the analyst and MAMC database experts. Because we needed to tie adverse events with staffing, the adverse event data had to be merged with the shifts in which they occurred.

Data Analysis

In order to analyze the associations between staffing and the occurrence of adverse events, the "events" database was merged with the shift level staffing and census database. Medication administration errors (ME), patient falls, falls with injury, ad needlestick injuries (NS) were coded as either 0 or 1, indicating the absence or presence, respectively, of the particular adverse event each shift. In addition, a shift composite outcome was created, defined as the presence of any adverse occurrence (AO) out of those events explained above.

Analysis Aim #1: For each unit type (medical, surgical, ICU, stepdown) and controlling for hospital size (small, large), do structural variables affect outcomes at the shift level?

At the outset of analysis, the entire data set was evaluated for extreme and missing data. Extreme data elements, assumed to be data entry errors, were recoded as missing. Last value carried forward was used to impute missing census (7% of shifts), staffing values (2% of shifts), and patient acuity (35% of days) information. This method was chosen on the basis of observations that census and patient acuity values were positively autocorrelated. Shifts missing all outcome measures were excluded from all analysis, and those with partial outcome information were excluded only from analysis where the specific outcome was missing.

Because multiple outcomes per shift were extremely rare (e.g., 0.08% of shifts had 2 medication errors and less than half of that had 3), all outcomes were recoded into dichotomous variables, 0 or 1, indicating the absence or presence, respectively, of an adverse event on a shift. The probability of each adverse event was modeled by using hierarchical logistic regression because the outcome variables were dichotomous. This modeling framework facilitates the analysis of multi-level (clustered) data by decomposing the overall variation in outcome attributable to each level while acknowledging the intra-cluster correlations. In this analysis, we used three data levels: shift (lowest), days, and nursing units (highest). Each data level has its own error term, so that the model could separate the three sources of variation (i.e., at the shift, day, and unit levels).

We explored the relationship of outcomes to shift time-of-day using indicators for the three day periods (morning, evening, night) and to day of the week by incorporating indicator variables for each day and for grouped days based on the resulting similarities in their estimated coefficients. Yearly effects were measured with indicator variables for each study year, 2003 to 2006.

It is well known that smaller hospitals have many differences in patient care characteristics compared to larger ones (e.g., less specialization, differences in organizational and structural factors, differences in working conditions, differences in staffing and skill mix, etc.). Therefore, we adjusted for small and large hospital size, defined as 50 beds or less and 100 beds or more, respectively. There was one medium sized hospital, defined as 51 to 99 beds. Since its characteristics mirrored the larger hospitals (teaching hospital and designated medical center), it was subsumed into the large hospital category. Since there were no additional unit or hospital level covariates, and to avoid a more complex model with four levels, hospital size was included as a unit level variable.

The models were estimated under a Bayesian framework that assigns non-informative prior probability distributions to all unknown parameters. Posterior distributions of the model parameters (conditional on the data) were derived by using Markov Chain Monte Carlo methodology. For each outcome, we used a single Gibbs sampler string

implemented with WinBUGS software (Spiegelhalter, Thomas, Best, & Lunn, 2003), with a burn-in of 500 iterations and with a further 4500 iteration used for inference. Starting values for parameters were calculated using standard logistic regression models. Estimated posterior means for odds ratios (ORs) are reported with their corresponding 95% confidence sets (CS). Confidence sets in Bayesian statistics are similar in interpretation to confidence levels in classical statistics. In addition to the staffing measures of interest, regression covariates included hospital size, shift (day, evening, night), daily acuity, year, and daily census. For comparability and simplicity of presentation, we chose to fit and report an identical model specification to all outcomes and across all unit types. There was no adjustment for multiple testing in this analysis. Unit types were analyzed separately.

Aim #2: Explore the effects of patient turnover and census on the relationship between structural variables and outcomes.

The effect of census was included in the initial analysis; however, the ADT variable was not used. The turnover variable had approximately 41% missing data and would have taken additional extensive analyses to determine the missing data mechanism (missing at random or not at random), and therefore, whether or not the ADT variable could be imputed and with what imputation method. Because we did not know at the beginning of this project what variables we would actually analyze (since that depended on the reliability and validity analysis in MilNOD III, the previous study), it was determined that this particular variable would be one we would not include in the models due to the extent of missing data.

Aim #3: Over time, have MilNOD participating facilities decreased their use of restraints?

This aim was analyzed with the same type of Bayesian HLM model as previously explained in Aim #1. The model was specified using repeated measurements of restraint prevalence for the unit quarterly studies. Data were weighted by the number of patients in each prevalence survey. Unit types were analyzed separately.

Aim #4: Controlling for unit type, are structural variables measured on day of observed restraint assessment associated with restraint prevalence?

Repeated measurements of restraint prevalence for unit quarterly studies was used to specify the models. Data were weighted by the number of patients included in the survey. Compound symmetry covariance structure was used to represent equal correlation in all units for study outcomes within the same unit.

Aim #5: Controlling for unit type, are structural variables associated with pressure ulcer prevalence (hospital-acquired stage II [HAPU2] and greater)?

For this analysis, the models were specified using repeated measurements of HAPU2 prevalence for the unit quarterly studies. Data were weighted by the number of patients in each prevalence survey. This aim was analyzed with the same type of Bayesian HLM model as previously explained in Aim #1. Compound symmetry covariance structure was used to represent equal correlation in all units for study outcomes within the same unit.

The same number of units and quarters were used in both the restraint and the pressure ulcer analyses, since these two prevalence studies were conducted together.

Aim #6: Controlling for patient risk (Braden score, BUN, Creatinine, Albumin), determine which units have a greater incidence of hospital-acquired pressure ulcers stage II or greater.

and

Aim #7: What variables, if any, predict good versus poor performance related to pressure ulcer prevention? Good performance is indicated by having high risk and low pressure ulcer prevalence. Poor performance is defined as low risk and high pressure ulcer prevalence.

Units with Braden scores $\leq$ 16 and HAPUs $\leq$10, were classified as good performers, since this indicates an at-risk Braden score but a low prevalence of HAPU2s. Poor performers were classified as having Braden scores of >16 and HAPU2 prevalence of >10%. Structural variables were compared between the two groups. Most good and poor performing units were critical care. Therefore, the analyses were restricted to comparing structural variables within critical care units only. To remove variation due to a small number of patients surveyed, comparisons were further restricted to those critical care units in which 5 patients or more were surveyed. T-tests were used to compare structural variables between the 3 "good" performers and the 7 "poor" performers.

Aim #8: Which variables predict patient's report of satisfaction (overall and various aspects)?

Patient satisfaction was measured with the Patient Satisfaction with Nursing Care Questionnaire (Jacox, Bausell, & Mahrenholz, 1997). Response rates were previously discussed. The instrument measures three dimensions of satisfaction: satisfaction with technical skills of the nurse, satisfaction with caring, and satisfaction with teaching about care after discharge. In order to provide comparisons to what CalNOC measured, individual items were also examined. The scale for this instrument is 1 to 7, with higher numbers indicating more satisfaction. Our plan was to analyze this variable using hierarchical linear modeling.

Aim #9: Does staffing and staff category impact how nursing personnel respond when surveyed about the work environment and

nursing job satisfaction?

The nurse survey data set which included job satisfaction and work environment variables was merged with the staffing and patient turnover data set as follows. For each individual responding to the survey, the staffing and patient turnover data for their particular unit was aggregated to the month that their survey was returned. For example, a survey returned in June of 2006 was merged with the staffing data for that unit for the month of June 2006. Thus every case (i.e., survey) was populated with the staffing variables aggregated to the month that the survey was returned. SAS version 9.2 was used to analyze the data.

Descriptive statistics summarized the sample characteristics. Variables were screened for distribution and collinearity before constructing regression models. The outcome variable, job satisfaction, originally a five category variable was dichotomized into 3 or 3 and 4 = "satisfied" and 1 and 2 = "dissatisfied". Generalized linear mixed model analysis was used with a binomial distribution and logit link function. The models included a covariance structure that accounted for the clustering of nurses within units. The following staffing variables were then added to the model: RN skill mix, military mix, and total nursing care hours, and patient turnover rate (admission, transfers, and discharges/census). The Generalized Linear Mixed Models used in the analysis were fit by maximum likelihood methods. Goodness of fit for the final model was assessed with a chi-square likelihood ratio test.

Actual analysis of the data was conducted at both the University of San Francisco by Dr. Moshe Fridman (for the first seven aims) and at The University of Alabama at Birmingham by COL (ret) Patrician in conjunction with analyst, Dr. Andres Azuero for the final three aims.

Results

Expansion Aim: **Expand the number of participating MilNOD military treatment facilities (MTF) from seven to fourteen. These would include MTFs representing all three branches of the military (Army, Navy and Air Force).**

The initial aim to include fourteen sites representing all three branches of the military had to be modified during the study due to facility closures and realignment, as well as inability to get IRB approval at one site. Thirteen facilities, of varying sizes and TRICARE regions, ultimately enrolled and participated. These facilities did, however, represent all three branches of the military as well as small and large facilities.

Table 8

Final Status of MilNOD Data Collection from Participating MTFs During MilNOD III/IV

Military Treatment Size (Location)	Service	Size	Data Collection Period[a]	N Days	N Shifts
Walter Reed AMC (Washington, DC)	Army	Large	Jul 03–Jun 06	1095	3285
Madigan AMC (Tacoma, WA)	Army	Large	Jul 03–Jun 06	6727	20181
[b]Brooke AMC (Fort Sam Houston, TX)	Army	Large	Dec 04–Jun 06	5589	16767
[b]Wilford Hall Medical Center (Lackland AFB, TX)	Air Force	Large	Jul 05–Jun 06	1834	5502
[b]National NMC (Bethesda, MD)	Navy	Large	Oct 05–Jun 06	1360	4080
[b]NMC San Diego (San Diego, CA)	Navy	Large	Jan 06–Jun 06	900	2700
Womack AMC (Fort Bragg, NC)	Army	Medium	Oct 03-Jun 06	3285	9855
Malcolm Grow Medical Center (Andrews AFB, MD)	Air Force	Small	Oct 03-Mar 05	1815	5445
[b]Naval Hospital Bremerton (Bremerton, WA)	Navy	Small	Sep 05–Jun 06	561	1683
DeWitt ACH (Fort Belvoir, VA)	Army	Small	Oct 03-Mar 06	2008	6024
[b]Naval Hospital Oak Harbor, (Whidbey Island, WA)	Navy	Small	Sep 05–Jun 06	277	831
[b]Bassett ACH (Fort Wainwright, AK)	Army	Small	Jun 04–Jun 06	759	2277
[b]3rd Medical Group (Elmendorf AFB, AK)	Air Force	Small	Jul 05–Jun 06	728	2184
	TOTALS			75,751	227,253

Note: AMC = Army Medical Center; ACH = Army Community Hospital; AFB = Air Force Base; NMC = Naval Medical Center

[a]Does not include data run-in period. [b]Indicates facility new in MilNOD IV.

Analysis Aim #1: For each unit type (medical, surgical, ICU, stepdown) and controlling for hospital size (small, large), do structural variables affect outcomes at the shift level?

Table 9 provides the shift-level covariates summarized by unit type, as well as number of shifts that are included in the analyses. The table clearly demonstrates a progression from least to most acute patients in terms of nursing care hours and skill, as one would expect moving from medical surgical units to critical care. Figure 1 shows the observed rate of each adverse event by unit type. The rates of all adverse events are low when viewed from the shift level. Medication administration errors occurred more frequently than did falls.

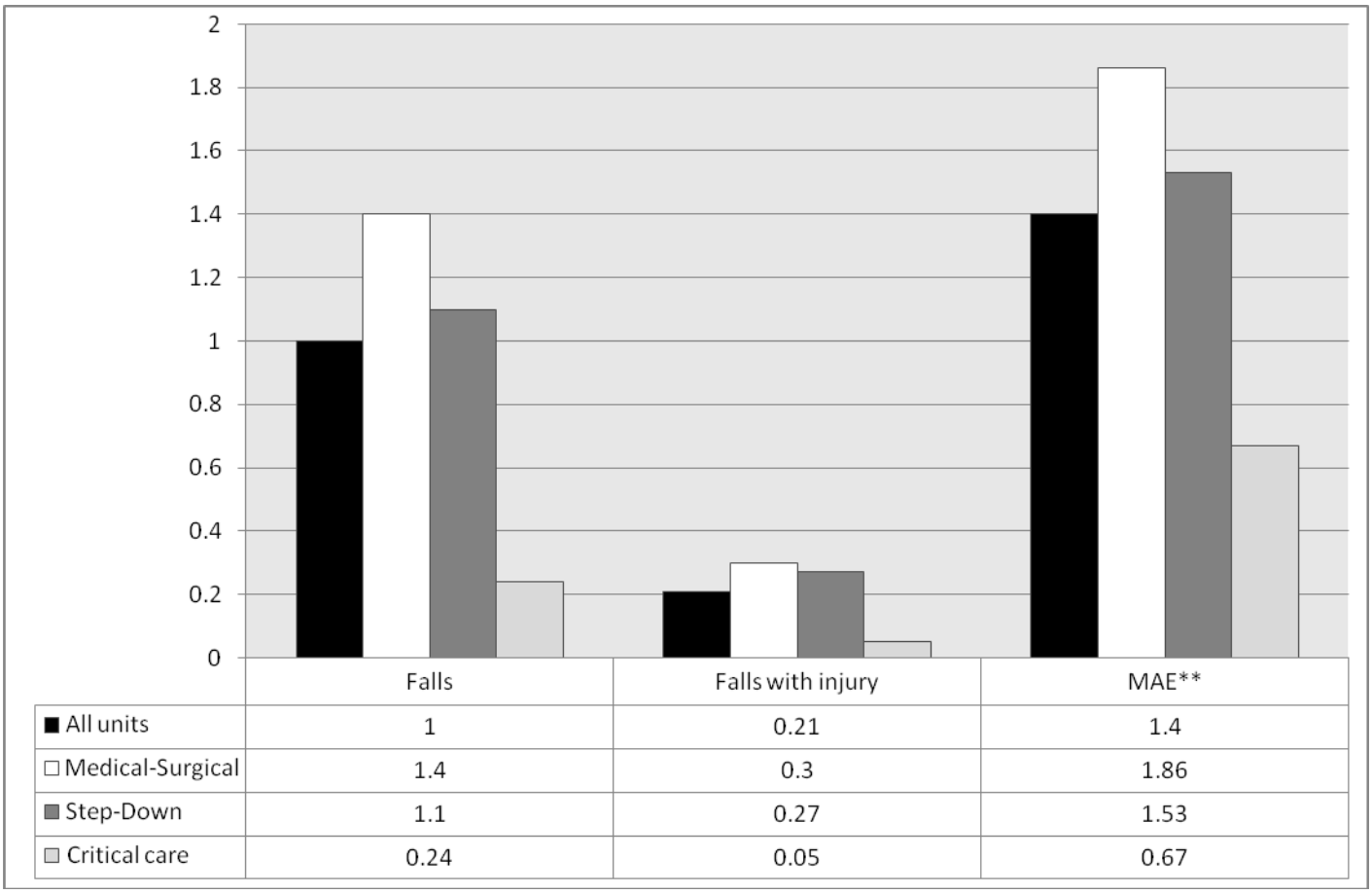
Table 9

Shift Level Covariates by Unit Type

Variable	Medical-Surgical (N=57,913 shifts)	Step-Down (N=18,039 shifts)	Critical Care (N=35,570 shifts)
Shift census	15.68 ± 7.18	10.63 ± 5.54	5.82 ± 2.87
Provider type by proportion of total hours			
% RN	51 ± 14	0.58 ± 0.17	0.77 ± 0.19
% LPN	0.22 ± 0.17	0.24 ± 0.18	0.14 ± 0.17
% NA	0.28 ± 0.15	0.19 ± 0.15	0.09 ± 0.17
Provider category by percent of total hours			
% Active military	0.44 ± 0.28	0.36 ± 0.24	0.41 ± 0.32
% DoD civilian	0.34 ± 0.24	0.39 ± 0.26	0.47 ± 0.31
% Contract	0.19 ± 0.19	0.22 ± 0.19	0.08 ± 0.14
% Reserve	0.027 ± 0.09	0.03 ± 0.08	0.05 ± 0.11
Nursing care hours per patient shift (NCH PPS)			
Total	4.29 ± 2.84	5.43 ± 2.97	9.42 ± 6.27
Licensed	3.02 ± 1.99	4.38 ± 2.46	7.99 ± 4.08
RN	2.15 ± 1.60	3.16 ± 2.09	6.87 ± 3.90
LPN	0.87 ± 0.96	1.22 ± 1.12	1.12 ± 1.70
# Patients per RN	4.82 ± 2.37	3.26 ± 1.59	1.46 ± 0.73

Note: mean ± SD reported; N=111,552 shifts with complete staffing data

Figure 1.
*Rates of Outcomes by Unit Type**



	Falls	Falls with injury	MAE**
All units	1	0.21	1.4
Medical-Surgical	1.4	0.3	1.86
Step-Down	1.1	0.27	1.53
Critical care	0.24	0.05	0.67

* Rates are calculated based upon percents of shifts with the event occurrence. Of 99,412 shifts with complete data, 974 had a fall. Of 99,338 shifts with complete data, 211 falls occurred that resulted in injury. Of 97,655 shifts with medication administration error data, 1,395 had a documented medication error.
**MAE, Medication administration errors.

Falls and Falls with Injury

Tables 10 and 11 show the results of analyses for falls and falls with injury, respectively. A greater proportion of RNs relative to unlicensed assistive personnel (the comparison category) (higher skill mix) was significantly associated with fewer falls in medical-surgical and critical care units but not in step-down units. Fewer falls were associated with a higher percentage of DoD civilian nurses working on a shift. A greater number of

nursing care hours per patient per shift was significantly associated with a decreased likelihood of both falls and falls with injury. Increased acuity was associated with increased falls, although this finding was statistically significant for medical-surgical units only. Increased patient census was significantly related to falls in both step-down and medical-surgical units. More falls (but not more of those with injury) occurred on the night shift, but day of the week was not significantly associated with falls. Falls were less prevalent in the final years of the study.

Table 10

Predictor	Medical-Surgical OR (95% CS)	Step-Down OR (95% CS)	Critical Care OR (95% CS)
Shift level			
Evening shift	1.14 (0.94-1.37)	0.82 (0.55-1.19)	0.98 (0.57-1.57)
Night shift	**1.36 (1.12-1.63)**	1.13 (0.77-1.61)	0.82 (0.45-1.34)
Skill mix (10% decrease)			
% RN	**1.11 (1.00-1.21)**	1.06 (0.95-1.18)	**1.20 (1.07-1.39)**
% LPN	**1.08 (1.00-1.17)**	1.05 (0.94-1.16)	1.03 (0.90-1.20)
Staff category (10% decrease)			
% Military	**1.09 (1.03-1.17)**	**1.09 (1.00-1.19)**	**1.14 (1.01-1.28)**
% Civilian	**1.48 (1.20-1.81)**	**1.33 (1.11-1.51)**	**1.36 (1.00-1.73)**
% Contract	**1.17 (1.10-1.26)**	1.05 (0.94-1.16)	1.13 (0.98-1.30)
Total NCHPPS (1 hour decrease)	**1.07 (1.01-1.14)**	**1.14 (1.03-1.28)**	**1.11 (1.02-1.23)**
Day level			
Day of week: Monday	1.24 (0.99-1.55)	0.79 (0.52-1.24)	0.80 (0.42-1.68)
Census (increase of 3 patients)	**1.17 (1.11-1.27)**	**1.29 (1.12-1.40)**	1.00 (0.89-1.12)
Acuity (1SD increase)	**1.13 (1.02-1.27)**	1.00 (0.85-1.23)	0.98 (0.72-1.31)
Year: 2003	1.32 (0.94-1.80)	1.18 (0.55-1.92)	0.80 (0.35-1.49)
2004	**1.58 (1.22-2.01)**	1.47 (0.75-2.31)	0.71 (0.30-1.27)
2005	1.20 (0.90-1.50)	0.90 (0.55-1.41)	1.09 (0.52-2.41)
Unit level: Large hospital	**2.34 (1.18-4.19)**	. . .	**6.77 (2.59-12.59)**

*Hierarchical Logistic Regression Modeling Results for Falls**

* Odds ratios are reported with their corresponding 95% confidence sets (CS; similar in interpretation to confidence intervals, but conceptually different in that they are derived from conditional distribution of the parameter given the data as opposed to conditional distribution of the data given the parameter in classical methods).
RN, registered nurse; LPN, licensed practical nurse; UAP, unlicensed assistive personnel; NCHPPS, nursing care hours per patient shift; OR, odds ratio; CS, confidence set. Reference group excluded for each categorical variable: Day shift for shift time, UAP for provider type, Reserve for provider category, 2006 for year, Tuesday-Sunday for day of week, and Small

hospital for hospital size. Bolding indicated the 95% CS excludes the value of 1. P values are not applicable in Bayesian methods. Only large hospitals in the sample had step-down units.

Predictor	Medical-Surgical OR (95% CS)	Step-Down OR (95% CS)	Critical Care OR (95% CS)
Shift level			
Evening Shift	1.09 (0.72-1.62)	0.80 (0.37-1.53)	1.17 (0.38-2.83)
Night Shift	1.24 (0.80-1.82)	0.71 (0.32-1.36)	1.11 (0.40-2.51)
Skill mix (10% decrease)			
% RN	**1.30 (1.17-1.49)**	1.05 (0.91-1.23)	**1.36 (1.18-1.55)**
% LPN	1.18 (0.10-1.33)	1.03 (0.88-1.20)	1.06 (0.90-1.23)
Staff category (10% decrease)			
% Military	**1.14 (1.04-1.27)**	1.10 (0.96-1.26)	1.12 (0.98-1.28)
% Civilian	**1.48 (1.11-1.76)**	**1.50 (1.09-1.90)**	1.27 (0.96-1.46)
% Contract	**1.18 (1.08-1.30)**	1.07 (0.92-1.25)	1.14 (0.96-1.34)
Total NCHPPS (1 hour decrease)	**1.15 (1.02-1.33)**	**1.25 (1.00-1.67)**	**1.51 (1.22-1.86)**
Day level			
Day of week: Monday	**0.76 (0.56-0.71)**	0.95 (0.27-1.94)	1.44 (0.93-2.37)
Census (increase of 3 patients)	1.03 (0.95-1.14)	**1.57 (1.34-2.01)**	1.04 (0.79-1.15)
Acuity (1SD increase)	1.09 (0.89-1.22)	0.80 (0.40-1.52)	1.07 (0.76-1.99)
Year: 2003	**2.43 (1.24-4.74)**	1.51 (0.70-3.17)	**1.54 (1.08-4.69)**
2004	**3.32 (2.22-5.51)**	1.34 (0.63-2.48)	1.97 (0.51-3.92)
2005	1.78 (0.97-3.00)	0.49 (0.16-1.06)	0.74 (0.26-3.62)
Unit level: Large hospital	**7.19 (2.32-17.31)**	. . .	**20.16 (4.78-45.74)**

Table 11

*Hierarchical Logistic Regression Modeling Results for Falls with Injury**

* RN, registered nurse; LPN, licensed practical nurse; UAP, unlicensed assistive personnel; NCHPPS, nursing care hours per patient shift; OR, odds ratio; CS, confidence set. Reference group excluded for each categorical variable: Day shift for shift time, UAP for provider type, Reserve for provider category, 2006 for year, Tuesday-Sunday for day of week, and Small hospital for hospital size. Bolding indicated the 95% CS excludes the value of 1. P values are not applicable in Bayesian methods. Only large hospitals in the sample had step-down units.

Medication Errors

Results of the analysis of medication administration errors are depicted in Table 12. As with falls, an increased proportion of RNs on a shift was significantly associated with fewer medication administration errors in medical-surgical and critical care units. A

higher proportion of DoD civilian nursing staff was associated with fewer medication administration errors, particularly in step-down and critical care units.

A higher number of total nursing care hours per shift was significantly associated with a decrease in the likelihood of a medication error occurring on a shift in medical-surgical and critical care units. Night shift had significantly fewer medication administration error occurrences. An increased daily census and increased acuity were significantly

Predictor	Medical-Surgical OR (95% CS)	Step-Down OR (95% CS)	Critical Care OR (95% CS)
Shift level			
Evening Shift	0.97 (0.83-1.14)	0.78 (0.56-1.06)	0.90 (0.64-1.22)
Night Shift	**0.43 (0.36-0.52)**	**0.46 (0.31-0.66)**	**0.41 (0.27-0.59)**
Skill mix (10% decrease)			
% RN	**1.13 (1.04-1.23)**	1.03 (0.91-1.19)	**1.17 (1.06-1.35)**
% LPN	**1.10 (1.01-1.20)**	0.95 (0.85-1.10)	1.05 (0.94-1.20)
Staff category (10% decrease)			
% Military	1.07 (0.98-1.20)	0.95 (0.84-1.10)	1.08 (0.97-1.20)
% Civilian	1.38 (0.98-1.87)	**1.67 (1.09-2.39)**	**1.47 (1.00-2.01)**
% Contract	1.06 (0.96-1.18)	0.96 (0.84-1.12)	1.03 (0.90-1.17)
Total NCHPPS (1 hour decrease)	**1.13 (1.06-1.21)**	1.02 (0.95-1.12)	**1.05 (1.01-1.10)**
Day level			
Day of week: Monday	0.82 (0.64-1.01)	1.09 (0.69-1.66)	1.00 (0.59-1.57)
Census (increase of 3 patients)	**1.07 (1.00-1.15)**	**1.36 (1.10-1.60)**	**1.14 (1.04-1.25)**
Acuity (1SD increase)	**1.13 (1.01-1.25)**	0.97 (0.70-1.23)	0.90 (0.71-1.22)
Year: 2003	1.19 (0.96-1.54)	1.27 (0.65-2.27)	**0.46 (0.23-0.92)**
2004	1.17 (0.90-1.50)	**2.13 (1.25-3.55)**	0.87 (0.49-1.70)
2005	0.81 (0.64-1.03)	1.08 (0.59-1.84)	**0.61 (0.33-0.99)**
Unit level: Large hospital	1.34 (0.56-2.87)	. . .	**1.17 (0.62-3.97)**

Table 12

*Hierarchical Logistic Regression Modeling Results for Medication Errors**

* RN, registered nurse; LPN, licensed practical nurse; UAP, unlicensed assistive personnel; NCHPPS, nursing care hours per patient shift; OR, odds ratio; CS, confidence set. Reference group excluded for each categorical variable: Day shift for shift time, UAP for provider type, Reserve for provider category, 2006 for year, Tuesday-Sunday for day of week, and Small hospital for hospital size. Bolding indicated the 95% CS excludes the value of 1. P values are not applicable in Bayesian methods. Only large hospitals in the sample had step-down units.

associated with more medication administration errors. Annual trends varied, but medication errors were generally lower in subsequent study years.

Needlestick Injuries

Needlestick injuries had some associations with staffing as depicted in Table 13. Needlesticks were associated with shifts that had lower RN skill mix, a fewer proportion of civilian nurses, and decreased nursing care hours. Patient acuity was not associated with the odds of a needlestick injury on a shift.

Table 13

*Hierarchical Logistic Regression Modeling Results for Needlestick Injuries**

Predictor	Medical-Surgical OR (95% CS)	Step-Down OR (95% CS)	Critical Care OR (95% CS)
Shift level			
Evening	0.64 (0.31-1.13)	0.91 (0.31-2.06)	0.83 (0.34-1.69)
Night	0.58 (0.28-1.05)	0.72 (0.22-1.70)	**0.45 (0.16-0.99)**
Provider skill mix (10% decreased effect)			
% RN	**1.32 (1.14-1.54)**	**1.38 (1.18-1.60)**	**1.35 (1.18-1.57)**
% LPN	1.07 (0.92-1.27)	**1.24 (1.06-1.45)**	1.14 (0.96-1.36)
Provider category (10% decreased effect)			
% Military	1.10 (0.98-1.25)	**1.24 (1.06-1.45)**	1.07 (0.94-1.22)
% Civilian	**1.54 (1.00-2.12)**	**1.22 (1.05-1.44)**	1.14 (0.83-1.31)
% Contract	1.16 (0.99-1.36)	**1.21 (1.03-1.42)**	1.05 (0.89-1.25
Total NCH PPS (1 hour decrease)	**1.43 (1.15-1.89)**	0.97 (0.90-1.08)	**1.52 (1.28-1.89)**
Day level			
Day of week: Monday	0.77 (0.32-1.78)	1.06 (0.56-1.93)	1.80 (0.54-4.41)
Census (increase of 3 patients)	0.93 (0.77-1.06)	**0.83 (0.61-0.99)**	1.08 (0.93-1.16)
Acuity (1SD increase)	1.18 (0.88-1.55)	0.92 (0.59-1.31)	1.04 (0.62-1.66)
Year: 2003	1.37 (0.20-6.60)	**	**
2004	2.15 (0.48-11.28)	**	**
2005	0.99 (0.13-6.86)	**	**
Unit level: Large hospital	1.66 (0.60-4.08)	[a]	**12.54 (2.46-38.90)**

*NCHPPS = nursing care hours per patient shift. OR=Odds ratio; CS=Confidence Set.
Reference group excluded for each categorical variable: unlicensed assistive personnel for provider type, Reserve for provider category, day shift for shift time, Tuesday to Sunday for day of week.
Bolding indicated the 95% CS excludes the value of 1. P values are not applicable in Bayesian methods. [a]Only large hospitals in the sample had step-down units.

All Adverse Events Combined

All adverse events combined were analyzed to look at overall effects of staffing variables. Results are presented in Table 14 below.

Table 14

Hierarchical Logistic Regression Modeling Results for Any Adverse Occurrences

Predictor	Medical-Surgical	Step-Down	Critical Care
Shift time			
Evening	1.01 (0.89-1.15)	0.83 (0.65-1.04)	0.93 (0.71-1.20)
Night	**0.75 (0.65-0.85)**	**0.76 (0.57-0.97)**	**0.51 (0.37-0.68)**
Provider skill mix (10% decrease)			
% RN	**1.07 (1.00-1.16)**	1.07 (0.98-1.19)	1.10 (0.95-1.30)
% LPN	1.03 (0.96-1.13)	1.03 (0.93-1.15)	1.02 (0.90-1.16)
Provider category (10% decrease)			
% Military	1.04 (0.97-1.13)	1.06 (0.96-1.19)	1.06 (0.95-1.18)
% Civilian	**1.42 (1.10-1.79)**	1.29 (0.99-1.61)	**1.45 (1.00-2.03)**
% Contract	1.04 (0.97-1.13)	1.04 (0.93-1.18)	1.05 (0.93-1.18)
Total NCH PPS (decrease by one hour)	**1.08 (1.03-1.14)**	1.01 (0.97-1.07)	**1.05 (1.01-1.09)**
Day level			
Day of week: Monday	1.00 (0.85-1.16)	0.87 (0.63-1.20)	1.94 (0.65-1.34)
Census (increase of 3 patients)	**1.13 (1.08-1.18)**	**1.27 (1.13-1.44)**	**1.09 (1.01-1.18)**
Acuity (1SD increase)	**1.13 (1.04-1.23)**	1.03 (0.84-1.25)	1.01 (0.80-1.25)
Year: 2003	**1.50 (1.10-1.86)**	1.55 (0.94-2.56)	0.80 (0.42-1.38)
2004	**1.64 (1.37-1.95)**	**2.38 (1.57-3.52)**	1.31 (0.74-2.07)
2005	**1.20 (1.01-1.42)**	**1.41 (1.01-2.07)**	1.13 (0.68-1.67)
Unit level: Large hospital	0.70 (0.23-1.65)	[a]	1.57 (0.38-4.77)

*NCHPPS = nursing care hours per patient shift. OR=Odds ratio; CS=Confidence Set.
Reference group excluded for each categorical variable: unlicensed assistive personnel for provider type, Reserve for provider category, day shift for shift time, Tuesday to Sunday for day of week.
Bolding indicated the 95% CS excludes the value of 1. P values are not applicable in Bayesian methods. [a]Only large hospitals in the sample had step-down units.

Aim #2: Explore the effects of patient turnover and census on the relationship between structural variables and outcomes.

The effect of census is included in the above analysis; however, the ADT variable was not used. The turnover variable had approximately 41% missing data. Additional analyses are necessary to determine whether or not the missing data was missing at random or not at random, and therefore, whether or not the ADT variable could be imputed and with what imputation method. Because we did not know at the beginning of this project what variables we would actually analyze (since that depended on the reliability and validity analysis in MilNOD III, the previous study), it was determined that this particular variable would be one we could not include in the models due to the extent of missing data.

A higher census was associated with lower needlestick injuries and lower medication errors and higher falls with injuries on in step down units, as well as higher adverse events overall in all three unit types. Step down units appear to be more sensitive to differences in census.

Aim #3: Over time have MilNOD participating facilities decreased their use of restraints?

A total of 54 units were included in the analyses; however because of the staggered nature of site participation, the same units were not included every year. A total of 132 quarters were analyzed, representing the 54 participating units. Table 15 lists the observed restraint rates (weighted by patient numbers) by unit type per year.

Table 15

Observed Restraint Rates

Restraint Prevalence	2003	2004	2005	2006
Med-Surg	4.14	1.82	1.09	0.93
Stepdown	2.50	6.06	1.14	2.90
Critical Care	17.39	38.89	17.65	32.26

Small hospitals had too few surveys for meaningful analysis. Medical-surgical units has a downward trend in restraint prevalence, but this was not statistically significant. Critical care units actually increased restraint prevalence over the years of the study (Table 15).

Table 16 shows trend p values for changes in restraint prevalence over time. Only critical care unit trends were statistically significant, but in the wrong direction; critical care units increased restraint use over the study period.

Table 16

Change in Restraint Prevalence over Time

Model results by unit type	2003	2004	2005	2006	trend p-value
Medical-Surgical Units: 29 units; 69 quarters					
Δ in restraint prevalence	0	-2.15	-2.91	-2.81	.292
p value	-	0.24	0.07	0.09	
Step down Units: 8 units; 23 quarters					
Δ in restraint prevalence	0	3.22	-1.21	1.61	0.17
p value		0.18	0.54	0.44	
Critical Care Units: 18 units; 43 quarters					
Δ in restraint prevalence	0	24.17	-6.05	7.40	0.03
p value	-	0.03	0.50	0.45	

Note: Estimated from repeated measurement models for each unit type (unadjusted).

Aim #4: Controlling for unit type, are structural variables measured on day of observed restraint assessment associated with restraint prevalence?

Repeated measurements of restraint prevalence for unit quarterly studies was used to specify the models. Data were weighted by the number of patients included the survey. Compound symmetry covariance structure was used to represent equal correlation in all units for study outcomes within the same unit.

None of the following variables were statistically significant in repeated measurement models for restraint prevalence, adjusting for hospital size and unit type: skill mix, staff category, NCHPPS, RN to patient ratio, daily census, and average acuity.

When separate models by unit type were analyzed, the following structural variables were statistically significant in relationship to restraint prevalence (models not shown):

1. A 10% increase in civilian staff was associated with a 0.7% increase in restraint prevalence in step down units only (p=0.022).

2. A 10% increase in contract staff was associated with a 5.8% increased restraint prevalence in critical care units only (p=0.040).

3. Each additional 1 hour of RN staffing (1 RN-NCHPPS) was associated with a 3.89% decrease in restraint prevalence (p=0.007).

Aim #5: Controlling for unit type, are structural variables associated with pressure ulcer prevalence (hospital-acquired stage II [HAPU2] and greater)?

For this analysis, the models were specified using repeated measurements of HAPU2 prevalence for the unit quarterly studies. Data were weighted by the number of patients in each prevalence survey. This aim was analyzed with the same type of Bayesian HLM model as previously explained in Aim #1. Compound symmetry covariance structure was used to represent equal correlation in all units for study outcomes within the same unit.

The same number of units and quarters were used in both the restraint and the pressure ulcer analyses, since these two prevalence studies were conducted together.

The major findings were:

1. Critical care units had the highest rates of HAPU2, followed by medical surgical units (see Table 17).
2. Average Braden scores were stable across unit types and years (Table 18).
3. For each 1 point increase in Braden scores, there was an increase in critical care units HAPU2 rates (by 11.15%, p = 0.003).
4. The only statistically significant staffing finding relative to HAPU2 prevalence was that a 10% increase in civilian staff was associated with a 14% decrease (p=0.05) in HAPU2s in medical surgical units only.

Table 17

HAPU2s Prevalence by Unit Type over Time

	2003	2004	2005	2006
Medical-Surgical	6.51	9.09	6.25	5.26
Stepdown	2.50	3.03	3.41	0
Critical care	17.39	11.11	18.82	22.58

Table 18

Average Braden Score by Unit Type over Time

	2003	2004	2005	2006
Medical-	18.6	18.1	18.8	18.3

Surgical				
Stepdown	18.5	18.1	18.6	18.3
Critical care	17.3	15.0	17.1	16.3

Aim #6: Controlling for patient risk (Braden score, BUN, Creatinine, Albumin), determine which units have a greater incidence of hospital-acquired pressure ulcers stage II or greater.

Even when controlling for higher risk, critical care units had the highest incidence of HAPU2s.When separating the units into good versus poor performers, 1 stepdown and 5 critical care units were in the "good category" and in the "poor category" were 9 ICUs, 1 stepdown and 5 medical-surgical units. See Table 19.

Aim #7: What variables, if any, predict good versus poor performance related to pressure ulcer prevention? Good performance is indicated by having high risk and low pressure ulcer prevalence. Poor performance is defined as low risk and high pressure ulcer prevalence.

Units with Braden scores $\leq$ 16 and HAPUs $\leq$10, were classified as good performers, since this indicates an at-risk Braden score but a low prevalence of HAPU2s. Poor performers were classified as having Braden scores of >16 and HAPU2 prevalence of >10%. Structural variables were compared between the two groups. Most good and poor performing units were critical care. Therefore, the analyses were restricted to comparing structural variables within critical care units only. To remove variation due to a small number of patients surveyed, comparisons were further restricted to those critical care units in which 5 patients or more were surveyed. T-tests were used to compare structural variables between the 3 "good" performers and the 7 "poor" performers. Table 19 presents the statistically significant differences. Good performers had a higher contract mix as compared to poor performers. Good performing units had a higher number of patients per RN as compared to poorly performing units. Good performers had 0% reservists and poor performers averaged 6.5% reserve staff, but this was not statistically significant. Poor performers had HAPU2 rates 10 times higher than good performers.

Table 19

HAPU2 Prevalence: Good versus Poor Performing Critical Care Units

Variable	Good performers	Poor performers	t-test p-value
Contract mix	36.2%	11.5%	0.01
Pt:RNs	1.97	1.34	0.04

Also, restraint prevalence was an unexpected finding in that a higher restraint prevalence was associated with lower HAPU2 prevalence (not shown here).

Aim #8*:* Which variables predict patient's report of satisfaction (overall and various aspects)?

Patient satisfaction was measured with the Patient Satisfaction with Nursing Care Questionnaire (Jacox, Bausell & Mahrenholz, 1997). The instrument measures three dimensions of satisfaction: satisfaction with technical skills of the nurse, satisfaction with caring, and satisfaction with teaching about care after discharge. In order to provide comparisons to what CalNOC measured, individual items were also examined. The scale for this instrument is 1 to 7, with higher numbers indicating more satisfaction. Table 20 shows the scores.

Table 20

Patient Satisfaction Scores

Item or scale: Satisfaction with:	Mean (SD)	Range	Median	Mode
Caring	5.98 (1.44)	1-7	6.75	7
Technical skills	6.13 (1.28)	1-7	6.75	7
Discharge Teaching	5.68 (1.62)	1-7	6.00	7
Nursing care in general	5.93 (1.36)	1-7	6.42	7
Pain management	6.14 (1.37)	1-7	7	7
Overall Satisfaction	6.08 (1.47)	1-7	7	7

Note: N = 1576-1721 surveys

Patients were most satisfied with pain management and least satisfied with discharge teaching. A one-way ANOVA showed no significant differences on satisfaction ratings between hospitals on any of the components. A mixed models procedure in SAS was conducted to look for effects over time (years) and also between facilities. No significant effects were discovered. Because there were no between-facility differences in patient satisfaction, no further analysis could be conducted to evaluate effects of structural variables on patient satisfaction.

Aim #9: Does staffing and staff category impact how nursing

personnel respond when surveyed about the work environment and nursing job satisfaction?

To evaluate this aim, the Practice Environment Scale (PES) and its subscales from nurse survey data were merged with shift level data. Actual staffing data from the nurses' unit was averaged for that month. The aggregated staffing data was merged with the survey data to reflect average staffing that was experienced during the same month that the nurse submitted his/her survey. For example, a survey returned in June of 2006 was merged with the staffing data for that unit for the month of June 2006. Thus every case (i.e., survey) was populated with the staffing variables aggregated to the month that the survey was returned. A total of 1586 staff members completed the surveys (response rate 35%), with 997 providing complete responses to the PES survey.

We first analyzed the composite PES score. Using linear mixed models that accounted for the nesting of nurses within units, we found that higher total nursing care hours and being a military nurse were significantly associated with the report of a more favorable practice environment (see Table 21). The Collegial Nurse-Physician Relations (CNPR) subscale had a significant association not with nursing care hours, but with RN skill mix such that in environments with a higher RN skill mix, nurses reported a more favorable collaborative relationship with physicians. The Staffing and Resource Adequacy (SRA) subscale has a statistically significant inverse association with being an RN and a positive association with total nursing care hours. The Nurse Manager Ability, Leadership, and Support (NMALS), Nursing Foundations for Quality Care (NFQC), and Nursing Participation in Hospital Affairs (NPHA) subscales all has statistically significant associations with being a military nurse, i.e., military nurses rated these subscales as more favorable.

Table 21

Summary of Practice Environment Scale Results

Outcome	Associated with	Regression estimate	Standard Error	t-value	p
PES Composite	Military nurse TNCHPPS	.192 .016	.036 .007	5.40 2.10	<.001 .040
CNPR	Military nurse RN skill mix	.094 .517	.039 .175	2.41 2.95	.016 .005
SRA	RN TNCHPPS	-.143 .045	.057 .010	-2.53 4.39	.012 <.001
NMALS	Military nurse	.221	.043	5.17	<.001
NFQC	Military nurse	.190	.031	6.13	<.001
NPHA	Military nurse	.359	.035	10.33	<.001

Notes: See text above for abbreviations. Models included RN (yes/no), military (yes/no), total experience (years), RN skill mix, military mix, and total nursing care hours per patient per shift (TNCHPPS)

The nurse satisfaction analysis is described below.

Aim #10: Does patient turnover contribute to nurse dissatisfaction?

In addition to the merged data described above, patient turnover was added to the models predicting nurse satisfaction. The outcome variable, job satisfaction, originally a five category variable was dichotomized into “satisfied” and “dissatisfied”. Generalized linear mixed model analysis was used with a binomial distribution and logit link function. The models included a covariance structure that accounted for the clustering of nurses within units.

A total of 1586 staff members completed the surveys (response rate 35%), with 1438 providing responses to the job satisfaction question. The mean age of nursing personnel was 37.3 with a SD of 10.8. Most of the sample (78.33%) were RNs. Out of those that identified themselves as RNs, 46.7% (N=776) were military and 53.3% (N=680) were civilians. Nursing respondents had been in their current position for an average of 4.1 years with a total of 9.26 years of nursing experience (N=1481). A five point Likert scale ranging from 1 = "very dissatisfied" to 5 = "very satisfied" was used for the response set. Overall, respondents indicate that they were either very satisfied 23.99% or were satisfied with their current jobs 36.02%. Few were dissatisfied (15.37%) or very dissatisfied (9.53%). Overall, the nurse respondents were generally satisfied with their current jobs.

Among the independent variables, age and years experience were highly correlated (tolerance = 0.37), and age was dropped from further analyses. First, the individual nurse-level variables were entered into the model (provider type, category and years experience). Both being an RN and being a military nurse had significant associations with satisfaction, but in opposite directions. The odds of being satisfied were significantly higher for RNs than for non-RNs (OR 1.46, p .04); whereas the odds of being satisfied among military personnel were significantly lower than the odds for civilians (OR 0.66, p .01). Years experience had no effect on job satisfaction.

The following staffing variables were then added to the model: RN skill mix, military mix, and total nursing care hours, and patient turnover rate (admission, transfers, and discharges/census). None of the staffing variables nor patient turnover were associated with satisfaction, and thus it was decided to remove these variables from the model.

Because the researchers wanted to look more closely at the RN versus military effect, an interaction term was added to the model. The final model demonstrates a significant effect of military status, as well as a statistically significant interaction between RN and military status, such that although military personnel overall were less satisfied with their jobs (OR=0.49, p=0.0006), military personnel who were also RNs were significantly more satisfied than military non-RNs (OR=2.18, p=0.0162).

The researchers used the final model to calculate predicted probabilities, odds, and odds ratios to compare various categories of personnel. As Table 22 shows, among those providers who were LPN's and unlicensed personnel, the odds of being satisfied for civilians were nearly three times the odds for military personnel. Among military providers, the odds of satisfaction for RNs were over two times the odds for LPN's and UAPs.

The Generalized Linear Mixed Models used in the analysis were fit by maximum likelihood methods. Goodness of fit for the final model was assessed with a chi-square likelihood ratio test. The difference in -2 log likelihood between an intercept-only model and the final model (with three parameters for the fixed effects) was 261.9, which is highly significant with three degrees of freedom. Dispersion of the model was assessed with the estimated dispersion scale parameter, which, at a value of 0.93, suggested no considerable evidence of over- or under- dispersion. Thus, the model appeared to appropriately account for the variability in the data.

Table 22

Differences in Job Satisfaction by Skill Level and Provider Category.

Odds Ratios			**Estimate**	**95% C.I.**
civil non-RN	vs	civil RN	1.068	0.65 - 1.75
civil non-RN	vs	Mil non-RN	2.919	1.58 - 5.39
civil non-RN	vs	Mil RN	1.335	0.82 - 2.17
Mil RN	vs	Mil non-RN	2.186	1.33 - 3.57
Civilians	vs	Military	2.020	1.38 - 2.94
RN	vs	non-RN	1.353	0.94 - 1.93

Note: Mil = military

Discussion

In summary our findings show significant differences in adverse events by unit type and significant associations of staffing with adverse events, supporting the assumption that adverse events occur during shifts that are staffed with fewer personnel overall, and fewer RNs and civilian staff in particular. Differences in fall rates by unit type were expected because of the nature of patients' mobility restrictions in each type of unit. Differences in rates of medication administration errors were also expected based on the observation that critical care nurses care for fewer patients and thus may be more familiar with the medication regimens for each patient, whereas medical-surgical nurses care for more and may not be as familiar with each patient's specific medications. Needlestick injuries to nurses were constant across all unit types.

Relationships with RN skill mix were most notable in falls with injury; each 10% decrease in RN skill mix was associated with a 36% increase in the likelihood of falls with injury in critical care units and with a 30% increase on medical-surgical units. This association was greater on critical care units, where high acuity patients are beginning ambulation after critical illness. The RNs on those units could be more aware of underlying physiological implications of patient-specific medications, extended bed rest, illness, and injury matters that might not be well understood by other levels of nursing personnel. A decrease in RN skill mix was also associated with medication errors in medical surgical and critical care units and needlestick injuries in all three unit types.

There was a strong relationship between total staffing (nursing care hours per patient shift) and falls with injury. Depending on unit type, a 15-51% increase in falls with injury was observed with each decrease of 1 hour of nursing care per shift. This finding differs from a CALNOC report showing that staffing changes from mandated nurse- to-patient ratios were not associated with patient falls (Donaldson, Bolton, Aydin, Brown, Elashoff, & Sandhu, 2005). One explanation may be the relatively wide variation in staffing noted across shifts in our study. This variation is likely muted when staffing data are aggregated and analyzed at a monthly level, the procedure commonly used with other nursing outcomes databases. A smaller but significant effect was observed with medication errors. This 1 hour decrease in nursing care hours was also associated with a 43 and 52% increase in needlestick injuries on medical surgical and critical care units, respectively.

The percentage of staff on a shift who were DoD civilians had several interesting associations. A 10% decrease in the percentage of civilian staff on a given shift was associated with a 33-48% increased likelihood of falls, as much as a 67% increased chance of MAEs, as high as a 54% increase in needlestick injuries and decrease in hospital acquired pressure ulcer prevalence. To help explain this relationship, we examined the differences in demographics between military and civilian nurses from a cross-sectional annual survey of nurses from our participating hospitals. Noteworthy among the differences was the level of experience. Military nurses had on average 9 years less experience than the civilian nursing personnel (5 versus 14 years, respectively; $t = -17.88$, $p < 0.001$). A similar difference was also observed in a separate study using a different military hospital sample (Patrician, Shang, & Lake, 2010). This experience level difference reflects a distinction in career expectations between military and civilian nurses. Military nurses typically begin their careers as direct care provider staff nurses and are expected to advance into leadership positions and away from direct care. Civilian nurses do not have this expectation, infrequently hold non-direct-care positions, and are usually hired with at least 1 year of experience. Our study's personnel category may be serving as a proxy for experience, which other researchers have found to be associated inversely with MAEs and falls (Blegen, Vaughan, & Goode, 2001).

Our needlestick findings with relationship to experience are similar to those of Clark (2007) who examined surveys from 11,516 Pennsylvania nurses and found that nurses

with less than 5 years of experience were more likely to have sustained a needlestick injury in the preceding year. Experienced nurses have likely found ways to manage work demands more efficiently, not only to protect themselves from needlestick injuries but also to have a protective effect on the other staff working with them on a shift. Therefore, administrators must consider the level of experience, and not simply total numbers of staff, when scheduling their workforce.

In analyzing shift times, 41% fewer MAEs and 45% fewer needlestick injuries occurred on critical care units at night. This lower incidence may have resulted because fewer medications are administered during night shifts, fewer new or modified medication orders are received on night shifts and therefore fewer opportunities for error would exist, or there may be fewer interruptions during night shift medication dispensing. Likewise, there may be fewer opportunities for needlesticks not only because of fewer medications administered, but because fewer invasive procedures are done at night.

Although we found a decrease in falls, medication errors, and pressure ulcers over the duration of the study (Loan, Patrician, & McCarthy, 2011), there was no such trend in restraint prevalence. However, we did find small but significant increases in restraint use with a higher proportion of contract nurses in critical care and a 3.89% lower prevalence of restraint use with each additional hour of RN staff per patient per shift.

The prevalence of hospital acquired pressure ulcers, Stage 2 (HAPU2) were higher in critical care units, despite the finding that average Braden scores were fairly similar across all unit types. In critical care, however, each 1 point increase in the Braden score was associated with an 11.2% increase in HAPU2 rates. When classifying units as either good or poor performers relative to Braden scale and pressure ulcer rates, good performers had a higher contract mix and a higher number of patients per RN as compared to poor performers. These findings defy explanation and we will address our staffing measure used for the pressure ulcer analysis under the limitations section of this report.

Patient satisfaction with various aspects of care was high across all hospitals. Our only explanation is that once patients enter a military hospital, the care they receive meets their expectations, but we did not explicitly test this. Of note, the Veterans Health Administration (VA) also reports unusually high inpatient satisfaction (Oliver, 2007) It may be that federally administered and provided health care is actually superior to civilian healthcare because of higher quality, less budgetary (and care) restrictions, increased public scrutiny, or may be reflective of characteristics of those who choose to work in military or VA hospitals.

Nurse ratings of their practice environment was more favorable in military nurses, perhaps because military staff, more so than civilian staff, are expected to participate in hospital affairs, in continuing education and professional development, and to be groomed to take on leadership roles. An increase in total nursing care hours was associated with a more favorable rating of the practice environment overall, perhaps because better work environments tend to have better staffing. This was observed

most notable in the Staffing and Resource Adequacy (SRA) subscale, where we document a statistically significant association with actual total nursing care hours. Being an RN was associated inversely with the SRA subscale, perhaps because RNs feel the brunt of poor staffing more so than do LPNs or other staff, as they must supervise all staff and oversee care for the unit.

Nurse job satisfaction, contrary to many anecdotal reports in the literature, was not found to be associated with actual staffing nor RN skill mix. This was a surprising and unexpected finding, and the first time actual staffing was used as an independent variable to predict job satisfaction, leading us to the conclusion that it is not poor staffing that causes job dissatisfaction, but other conditions such as work environment, but we did not test this association. Satisfaction was dependent more so on ones' position in the hierarchy of the unit than on any of the staffing or patient turnover rates. Military LPNs and unlicensed personnel were the least satisfied of the categories and military in general tended to be less satisfied than civilians. RNs were more satisfied than non-RNs. This may be explained by the additional duties the military are required to perform, such as covering when civilians call in sick. Theoretically military staff are available 24 hours a day, 7 days a week and must abide by orders from superiors.

Conclusions and Implications

The use of multiple data collection sites permitted the accumulation of an extraordinarily large number of data points that may allow the investigators to uncover relationships among the structural and outcome variables. The use of 13 sites permitted the investigators to use hospital size as a control variable and unit type as a variable of interest. This large dataset has rich variability which may allow for discovery of new relationships. The limitations of using multiple data collection sites is the systematic error that can be introduced and the confounding effects of unmeasured but present hospital and/or unit-level variables. Using hospital size, unit –type and other site specific factors as control variables may minimize their confounding effect on the analysis.

Several very important questions remain, although their analyses was beyond the scope of this project. They are as follows:

1. How does patient turbulence affect the adverse events in this study? This can be done by simply using the data that is available or, more correctly, using an acceptable imputation method. The latter would require several sequential steps. First, we would need to determine the missing data mechanism in the ADT variable (missing at random, missing completely at random, or non-random missingness). Based upon the results, determine an imputation strategy and conduct the analysis as originally proposed. As a test of the validity of the imputation models, test the results obtained against simulated missing data of the same mechanism by using the portion of the data set with no missing values, removing a random percentage of values, and imputing using the same

models. This analysis will not only answer the research question #1 as originally posed, but will add to the methodological knowledge on imputation methods for various types of missing data mechanisms.

2. What are the effects of the practice environment on the relationships between the predictor and outcome variables in the shift level analysis. This is a complicated analysis because of the two possible and distinct relationships of the practice environment (and separate components of it) on the predictor-outcomes relationship. The environment may act as a moderator of the relationship, affecting it differently as the practice environment is better or is worse. As an example, a good practice environment may lessen the effect of poor staffing on outcomes because in a positive practice environment, workers could better mobilize resources such as team work and cooperation with other departments to get the work done safely. On the other hand, unfavorable work environments may worsen the effects of low staffing on outcomes such that poor outcomes would be experienced at relatively higher staffing than would be expected. There is some empirical evidence to suggest that this is the case; however it has never been tested at the shift level.

Alternatively, there could be a mediating effect of the practice environment on outcomes such that better staffing helps to create a positive work environment, which in turn, affects the outcomes in a positive way.

3. What effect does the practice environment and its subcomponents have on nurse job satisfaction. This is an important question and one that was not posed in the original study. There is a growing body of evidence suggesting that it is the work environment and not necessarily staffing that satisfies or dissatisfies nurses. Our analysis did not show any effect of staffing on nurse job satisfaction.

4. Should the PES should be used for all skill levels of nursing personnel? We do not know, for example, whether unlicensed assistive personnel and registered nurses would rate the same unit environment in the same manner.

5. What are the patient level risk factors for pressure ulcer development? A recent publication by Chapman and Kane (2010) indicated an increased risk of pressure ulcers among war wounded service members. Our data could help explore that association in more detail given that we have collected physiologic data (lab values) known to be risk factors for pressure ulcer development.

6. If we used a different measure of staffing in the pressure ulcer analysis, would our results differ? In looking back at the staffing metric used (staffing on the day of the pressure ulcer prevalence study), several anecdotal factors came to mind. First, additional staff were scheduled on the day of the pressure ulcer prevalence studies in all facilities, because the research team had requested staff nurse participation in the study. Those excess staff would have been counted within their respective shifts had they gone back to work the remainder of the shift following the pressure ulcer survey. thus, staffing may have been over-inflated on the day of the pressure ulcer prevalence

study. The research team now recommends looking at staffing 48 hours prior to a pressure ulcer survey – this measure would fit within the physiologic time of the development of a pressure ulcer.

Limitations

Several limitations must be mentioned. First, this study had two phases in that it was both database building and database analysis, and therefore, we did not know a priori which particular variables would be in the final analysis, because of reliability, validity, and missing data concerns. The amount of missing data precluded some of the analysis. Second, no causation could be implied since this was an exploratory, and not an experimental design.

Third, the use of self-reported unusual occurrence reports is frequently cited as a limitation. Many claim that reporting is a function of the patient safety climate, and not a true indication of the frequency of adverse events. We accept that we likely have underreporting of adverse events; however the fact that we find associations in light of both under-reporting and rare events is noteworthy. Many researchers suggest that falls are the most frequently reported of adverse events because they cannot be hidden from other staff members as perhaps medication errors can. In our data set, we find more medication errors reported that we do falls. Needlestick injuries have been shown to be underreported when using actual injury reports as compared to retrospective self reports (Aiken, Sloane, & Klocinski, 1997); however, retrospective reports are also error prone due to recall bias. The best way to document adverse events is through observation, but observation is extremely expensive making it unrealistic for a study that spans four years and thousands of shifts.

A fourth limitation was the selection of staffing measure to use in our pressure ulcer prevalence analysis. In hindsight, we discovered that units were typically staffed at higher levels during the prevalence study days because of the need to provide staff nurses for part of the day to conduct the surveys. Although their time away from the unit to conduct the surveys should not have been counted against the staffing hours for that day, extra staff were on hand on the units to assist the research teams with tasks such as turning the patients.

In contemplating the appropriate staffing metric to use for the pressure ulcer - staffing analyses, it became apparent that staff shortages on different days are theoretically associated with the different stage of development of the ulcer. For example, to determine if staffing was a factor in the development of the Stage 1 pressure ulcers detected on the pressure ulcer prevalence study day, we would need to look back to staffing in the 24 hours prior to the survey. Likewise, to detect staffing effects on HAPU Stage IIs or higher, we would need to look at staffing backwards in time 48-72 hours, because of the time factors in the physiologic development of Stage II HAPUs. We have the data to conduct these analyses to determine if there is a staffing effect at different times prior to the survey. Knowing which staffing measure to use would inform

future research in this area. This is yet another contribution to the field that can be answered with MilNOD data.

A final limitation was not collecting specific data on interventions that were being conducted at the time of the MilNOD. This was of course, beyond the scope of the study. However, having these data could help us to understand the changes in adverse events over time that our data show. We can only say that there was a change, not that the MIlNOD or anything else for that matter, helped produce the change. This leads back to the second limitation, the inability to attribute causation, even on a small scale in isolated units that may have had performance improvement projects to address some of the adverse events.

Significance of Research to Military Nursing

- The findings from this study support a working model for collecting and disseminating reliable, valid, and usable data across hospitals to support patient safety.
- Promoting the use of high-quality inpatient data can contribute to the development of evidence-based policies and procedures to monitor the effect of nurse staffing on clinical and service outcomes.
- The MilNOD was a first attempt in the military to collect performance data to compare like units in like hospitals with each other on indicators important to nursing.
- Although the military can and does adopt civilian research findings to its management practices, civilian data is limited in that the military has different categories of providers; we have shown here that this does make a differences in outcomes.
- Each shift must be staffed adequately not only with numbers of staff, and skill levels, but also with the right mix of experienced (i.e., civilian) staff.
- These data are useful for military nursing leaders to defend existing staffing levels and/or to justify additional staffing needs to their respective commanders.
- These data are useful for leaders to justify budgetary requirements for staffing.
- An adaptation of this model is currently being used as an interdisciplinary clinical outcomes database for patient safety metrics in Army medical facilities

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Outcomes Resulting From Study

Awards

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Lay Press

The *MilNOD Messenger* was distributed quarterly as a means of keeping all study team members connected to grant activities.

Possible Policy Implications

The MilNOD team was approached by the Army Medical Command Patient Safety Office to assist with a service-wide initiative to incorporate nursing-sensitive outcomes into a large patient safety database. It is anticipated that several MilNOD structural variables (skill mix, nursing care hours per patient day, etc.) will be included in this initiative.

Possible Change of Practice

Nurse Managers at various MilNOD sites have used their MilNOD data to re-examine staffing ratios and to convert paraprofessional (e.g. LPN) staff to professional (RN) staff positions in order to enhance quality nursing care. One site in particular, assigned more new military staff to the medical-surgical units with the lowest RN skill mix.

Many sites have used the outcome data for falls, medication administration errors, and pressure ulcer prevalence to focus on strategies to decrease incident rates and improve patient safety. An example of this would be the medical and stepdown units of one large medical center who both decided to launch a patient safety initiative to decrease fall rates using targeted strategies such as consistent documentation of the Fall Risk score, bed rounds to ensure alarms were activated and beds were in the low position, high risk patients were identified and moved closer to the nursing station, high risk patients were checked and offered assistance every 2 hours, devices such as floor mat alarms were

purchased, and a white board at the nursing station tracked how many fall-free days had occurred. These measures have been adhered to for over a year and continue to be key aspects in the success of the patient safety initiative to reduce falls.

Another example of a change in practice is related to the pressure ulcer prevalence surveys conducted as part of the MilNOD Study. Several facilities had never done pressure ulcer prevalence surveys before participating in MilNOD. With the assistance of several core MilNOD team members the facilities were able to educate nurses about skin care and staging of pressure ulcers, organize a team to inspect the skin of all patients in the hospital on a given day, and identify areas needing improvement related to pressure ulcer prevention. Training materials, including photographs to practice staging of pressure ulcers, were made available to any facility upon request. Electronic consultations were also conducted with remote sites when they faced challenging wound care issues

Table 23 provides information solicited from MilNOD sites regarding their prevention activities**.**

Table 23

MilNOD Pressure Ulcer Practice Enhancements across Participating MTFs (As of Feb 06)

% Of Participating Sites . . .	Before MilNOD	After MilNOD
➢ Collecting Regular Hospital Acquired Pressure Ulcer Data	36%	100%
➢ Using An Evidence-Based Pressure Ulcer Risk Assessment Tool	27%	100%
➢ Conducting A Pressure Ulcer Prevalence Study At Least Yearly	36%	100%
➢ Using Pressure Ulcer Staging Criteria That Are Evidence-Based & Current	25%	100%

Appendix A

Budget Report

Appendix B

Problems Encountered and Resolutions

The problem causing the longest delay to this study was the IRB approval process at participating sites. Each IRB requested different materials to be forwarded for review and revisions to the proposal were often required prior to final approval. One small issue delayed this approval for several months; the impact depended on the timelines of the IRB reviewing schedule. Additionally, Operation Iraqi Freedom (OIF) deployments were unanticipated and affected study implementation and progression, impacting personnel in all of the study facilities and affecting multiple facets of the study including the IRB process, site coordinators, and all levels of nursing leaders/managers. Deployment-related setbacks resulted in the need for additional training and briefings to site personnel and multiple, repeat explanations to Head Nurses and Chief Nurses.

A current DoD Assurance of Compliance with Human Subjects Protections is required for each DoD institution conducting human subjects research. Review of the MilNOD protocol for the Oak Harbor Naval Hospital was delayed until a new DoD Assurance of Compliance could be approved (approximately 12 months) by the Navy Bureau of Medicine and Surgery. The DoD Assurance of Compliance with Human Subjects Protections was finally obtained for Oak Harbor Naval Hospital Winter 2004. This unanticipated requirement provided an opportunity for the research team to learn the extent of preparatory work that may be required when other small MTFs are brought into the MilNOD study.

Eventually IRB approval was obtained at all of the 7 sites, representing three branches of the military, Army, Navy, and Air Force. Joint IRB approval for the two Navy facilities, Oak Harbor Naval Hospital and Naval Hospital Bremerton came from the regional IRB Headquarters at Naval Medical Center San Diego when a protocol was filed for MilNOD IV. However, approval was not received in time for the two original Navy sites to participate in MilNOD III. To highlight how time-consuming the problem was with the IRB process, the initial protocol packet was submitted in January 2003 and approval was only granted in December 2004. The study progresses as much as possible while waiting for the final approval. Projected personnel for all sites have been hired or assigned to the team and trained for the study. The MilNOD study team conducted site visits with Chief Nurses and reviewed study aims and site coordinator responsibilities at all seven original sites. Due to the delay in IRB approval for the Navy sites we were unable to fully meet our first aim. The Navy sites began data collection in September 2005.

A variety of other problems were encountered including identification of site-specific data sources, designation of data collectors, data acquisition and data management. Onsite training issues related to the database were as expected due to the high level of security required for the data collected in this project and the lack of familiarity with highly technological systems by most study personnel. Initially a File Transfer Point (FTP) was set up on the MAMC server which worked well until the MAMC Information Management Office directed the termination of the FTP facility-wide due to a new requirement for enhanced security. This resulted in the creation of the Microsoft product called a SharePoint portal that allows collaboration between multiple sites for the purpose of sharing documents and data with associated Windows securities. This is a highly secure password-protected site that is considered the preferred tool for

Government communications and data sharing. All site personnel received instructions about using this portal and were frequently taken through the site step-by-step by MAMC study staff. We have access to the MAMC developer by phone and email 7 days a week to assist with troubleshooting. It is an individual's responsibility to keep their password current to access the portal and instructions and reminders are sent out frequently. Occasionally the server is inaccessible for short periods of time but we know of no recent or chronic issues with the SharePoint portal.

A final problem was statistical support. Because the statistician who originally agreed to perform the analyses for this project was ultimately unable to assist, the CALNOC Consultants were approached in September 2007 and they agreed to coordinate the analysis of seven of the analysis specific aims; completing the entire analysis was beyond the scope of the remaining MilNOD budget at that time. Dr. Moshe Fridman performed the analysis and on August 10-11 of 2008, COL(ret) Patrician, Dr. Loan, and Dr. McCarthy traveled to the University of San Francisco to meet with team consultants Dr. Nancy Donaldson and Dr. Fridman. The one-day visit was spent reviewing the data preparation, model configurations, and statistical tests performed. Subsequently all study findings to date were discussed with full explanations by Dr. Fridman of his analytical methods. He also provided expert insight and interpretation of the data. Dr. Fridman analyzed most of the aims; the remainder were analyzed by Dr. Andres Azuero, funded by Dr. Patrician's endowment.

Appendix C

Psychometric Report #1

Reliability and Validity of Measures: PSNQ						
If no instrumentation was used for your study, check here ☐						
Directions: Please complete the questions below addressing demographic characteristics of your sample and overall sample size. For the tool identified in the attached cover letter, please complete the following questions regarding any reliability and/or validity testing you performed. Please note that this list is not meant to be exhaustive. If you performed other reliability and/or validity testing which is not listed, please identify the test, and report your findings under "other." If further space is needed, please attach additional pages. Please submit a copy of the tool if you made any modifications.						
Principal Investigator – Contact Information						
Name:	COL (ret) Patrician A. Patrician		**Telephone Number:**		**Work**	
Address:	[redacted]				**Home**	
	[redacted]		**E-mail:**	[redacted]		
Title of Study	Military Nursing Outcomes Database (MilNOD IV): Analysis and Expansion					
Demographic Characteristics of Sample						
Total sample size:	**Age Range:**	N/A		**Number**	**Service**	
	<19 yrs	19-60 yrs	>60 yrs	Other		See description below	Army
Male	Not assessed						Air Force
Female							Navy
							Marine
Number	**Race:**				**Number**	**Service Component:**	
Not assessed	Caucasian				Not assessed	Active Duty	
	African-American					Retired	
	Hispanic					Reserve	
	Asian/Pacific Islander					National Guard	
	Other (Describe)					Dependent	
Briefly describe defining characteristics of sample:						

Total sample size: 5 MTFs; 26 nursing units; 1170 nursing personnel and 1195 patients.

Service not specifically assessed, however, there was one Air Force MTF and 3 Army MTFs in the sample.

Instrument Reference					
Instrument Title:	Patient Satisfaction with Nursing Care Questionnaire (PSNCQ)			**Number of Scales:**	3, used 2
Instrument Publication Year:	1997			**Edition:**	NA
Authors:	Jacox, Bausell, & Marenholz				
Publisher:					
Journal or Book Title:	Outcomes Management for Nursing Practice				
Year:	1997	**Volume:**	1	**Page Numbers:**	20-28
Tool Modifications					
Did you modify this tool?	☒ **Yes (Answer A & B below)** ☐ **No**				
A. Briefly describe why modifications were made:	The instrument did not have a question on global satisfaction with nursing care, which was an indicator the research team wished to capture.				
B. Describe what modifications were made:	Added one question on overall satisfaction with nursing care.				
Directions: Please indicate any reliability and/or validity testing you did on this instrument. Please report findings of each scale next to the test.					
Check all that apply					

Reliability	Validity
☐ Internal-Consistency Reliability	Content Validity
☒ Cronbach Coefficient Alpha .98 for instrument	☐ Index of Content Validity (CVI)
☐ Kuder- Richardson (KR-20)	☐Other (please describe on back of form)
☐ Interrator Reliability	Criterion-Validity
☐ Intrarater Reliability	☐ Predictive
☐ Coefficient of Stability (test-retest)	☐ Linear Correlation
☐ Coefficient of Equivalence	Name of Criterion Measure Used:
☐ Other (please describe on back of form)	☐ Concurrent
	☐Linear Correlation

Reliability of Individual Scales		Name of Criterion Measure Used:
Scale Name	**Reliability**	☐ Construct Validity (include a copy of findings)
Patient Satisfaction with:		☐ **Multitrait-Multimethod**
Patient Education	.97	☐ Hypothesis testing
Discharge Teaching	.99	☐ Contrasted Group
		☐ Factor Analysis
		☐ Exploratory
		☐ Confirmatory
Please use back of form for additional scales		☐ Other (please describe on back of from)

Evaluation of Measure	
Would you recommend the use of this measure in your population to other researchers?	
☒ Yes. Please explain why.	This is a good instrument to measure satisfaction with hospital experience and more specifically nursing care. The instrument has four single item measures: satisfaction with hospital, food, medical care, and nursing care. It also has three subscales (of which we used one): Satisfaction with nurse's technical ability, caring, and teaching. All three have high Cronbach alphas: .95, .98, and .97 respectively. Because of our specific indicators, we were able to pick items out of this instrument to use as single item measures (satisfaction with pain management and overall nursing care). In this regard, the instrument is quite flexible.
☐ No Please explain why.	

Psychometric Report #2

Reliability and Validity of Measures: PES

If no instrumentation was used for your study, check here ☐

Directions: Please complete the questions below addressing demographic characteristics of your sample and overall sample size. For the tool identified in the attached cover letter, please complete the following questions regarding any reliability and/or validity testing you performed. Please note that this list is not meant to be exhaustive. If you performed other reliability and/or validity testing which is not listed, please identify the test, and report your findings under "other." If further space is needed, please attach additional pages. Please submit a copy of the tool if you made any modifications.

Principal Investigator – Contact Information

Name:	COL (ret) Patrician A. Patrician	**Telephone**		**Work**
Address:	NB 324, 1530 3rd Avenue South	**Number:**		**Home**
	Birmingham, AL 35294-1210	**E-mail:**	Ppatrici@uab.edu	
Title of Study	Military Nursing Outcomes Database (MilNOD IV): Analysis and Expansion			

Demographic Characteristics of Sample

Total sample size:		**Age Range:**	See description below			**Number**	**Service**
	<19 yrs	19-60 yrs	>60 yrs	Other		X	Army
Male	**Gender not assessed**					X	Air Force
Female							Navy
							Marine

Number	**Race:**			**Number**	**Service Component:**
Race not assessed	Caucasian			X	Active Duty
	African-American				Retired
	Hispanic			X	Reserve
	Asian/Pacific Islander				National Guard
	Other (Describe)				Dependent

Briefly describe defining characteristics of sample:

Total sample size 2003: 5 MTFs, 228 RNs, 123 LPNs and aides (351 total)
2004: 7 MTFs, 303 RNs, 177 LPNs and aides (480 total)

Age ranges: 2003: 19-66 years (RN 22-64 yrs; LPN/aides 19-66 yrs)
2004: 19-66 years (RN 22-66 yrs; LPN/aides 19-66 yrs)

Instrument Reference					
Instrument Title:	**Practice Environment Scale of the Nursing Work Index (PES-NWI)**			**Number of Scales:**	**5 + total score**
Instrument Publication Year:	**2002**			**Edition:**	NA
Authors:	Lake, Eileen				
Publisher:	Wiley Periodicals				
Journal or Book Title:	Research in Nursing & Health				
Year:	2002	**Volume:**	25	**Page Numbers:**	176-188

Tool Modifications	
Did you modify this tool?	☐ **Yes (Answer A & B below)** ☒ **No**
A. Briefly describe why modifications were made:	We used the NWI-R as reported in Aiken & Patrician (2000), but for the analysis, we used the PES-NWI items from the NWI-R.
B. Describe what modifications were made:	

Directions: Please indicate any reliability and/or validity testing you did on this instrument. Please report findings of each scale next to the test.

Check all that apply

Reliability	Validity
☐ Internal-Consistency Reliability	Content Validity
☒ Cronbach Coefficient Alpha See Below	☐ Index of Content Validity (CVI)
☐ Kuder- Richardson (KR-20)	☐Other (please describe on back of form)
☐ Interrator Reliability	Criterion-Validity
☐ Intrarater Reliability	☐ Predictive
☐ Coefficient of Stability (test-retest)	☐ Linear Correlation
☐ Coefficient of Equivalence	Name of Criterion Measure Used:
☐ Other (please describe on back of form)	☐ Concurrent
	☐Linear Correlation
Reliability of Individual Scales	Name of Criterion Measure Used:
	☐ Construct Validity (include a copy of findings)

Scale Name	Items	Reliability 2003	Reliability 2004
PES-NWI	29	.92	.93
Nsg Participation in Hosp Affairs	9	.84	.85
Nsg Foundations for Qual Care	9	.79	.82
Nsg Manager's Ability, Ldrshp	4	.81	.83
Staffing & Resource Adequacy	4	.77	.79
Nurse-MD Collaboration	3	.83	.77

Please use back of form for additional scales	☐ Other (please describe on back of from)
	☐ **Multitrait-Multimethod**
	☐ Hypothesis testing
	☐ Contrasted Group
	☒ Factor Analysis
	☒ Exploratory See explanation below
	☐ Confirmatory

Evaluation of Measure	
Would you recommend the use of this measure in your population to other researchers?	
☒ Yes. Please explain why.	I would recommend using the PES-NWI, but not the NWI-R in its entirety due to respondent burden.
☐ No Please explain why.	

Exploratory Factor Analysis:	An exploratory factor analysis was conducted on the 2003 and 2004 data sets using principal components analysis. In the 2003 data set, 7 factors with Eigenvalues greater than 1 were extracted and accounted for 62% of the variance in scores. Following varimax rotation with Kaiser normalization, factor loadings were examined. Factor #1 contained four of the nine items in the subscale, Nurse Participation in Hospital Affairs; four of the remaining five loaded on Factor #3. Six of the nine items from the Nursing Foundations for Quality Care Five subscale loaded on Factor #6; two loaded on Factor #7. The subscale, Head Nurse Ability is well represented by Factor #2, with the addition of the item "Head nurse consults daily with staff…" (loaded at .804). The items from the subscale, Staffing and Resource Adequacy all loaded on Factor #5 with loadings in the range from .617 to .819. The items from the subscale Nurse-Physician Collaboration all loaded on Factor 5 with loadings of .762 to .787. Whereas the subscales, Nursing Participating in Hospital Affairs and Nursing Foundations for Quality Care are less distinct than the other subscales, the instrument does measure distinct components of the nursing practice environment. This procedure was repeated in the 2004 data set. Five factors with Eigenvalues greater than 1 were extracted and accounted for 56% of the variance in scores. Factor #1 contained 7 of the 9 items in the subscale, Nurse Participation in Hospital Affairs. The two that did not load on Factor 1, actually loaded on Factor 2, along with the 4 items that comprise the subscale, Head Nurse Ability, Leadership and Support. Factor 3 contained 8 of the 9 items that comprise the subscale, Nursing Foundations for Quality Care. The one item that did not load on Factor 3 (active continuing education program), loaded on Factor #1, Nurse Participation in Hospital Affairs with a value of .650. Factor #4 contained the subscale, Nurse-Physician Collaboration, with loadings from .714 to .740. Finally Factor #5 contained the subscale, Staffing and Resource Adequacy (with loadings from .544 to .804). Overall, the subscales performed better in the 2004 sample, possibly because the increase in number available for analysis. The subscales are clearly measuring distinct concepts within the work environment. The one that is the least distinct than the others is Nurse Participation in Hospital Affairs. However, in the 2004 sample, the majority of the items (minus two) loaded together on a single factor. This provides evidence of construct validity of the PES-NWI.

Appendix D

Research Categorization Using TSNRP Areas of Research

Identify the main research priority investigated in this research study.
Please check one item for Primary (Required) and one item for Secondary Priority Areas (if appropriate)

Primary Research Priority Area: (Required)

___ Military Deployment Health

X_ Translating Knowledge & Research Findings into Practice in a Military Context

___ Evidence Based Practice

___ Recruitment & Retention of the Military Nursing Workforce

___ Developing & Sustaining Military Nursing Competencies

Secondary Research Priority Area:

___ Military Deployment Health

___ Translating Knowledge & Research Findings into Practice in a Military

___ Evidence Based Practice

___ Recruitment & Retention of the Military Nursing Workforce

___ Developing & Sustaining Military Nursing Competencies

Other *(fill in):* Clinical Resource Management

Identify 3-5 key words relating to the proposal. (Required)
(You MUST use the *CRISP Thesaurus* for key words. The thesaurus is on the web at: http://crisp.cit.nih.gov/crisp/crisp_help.help

1. Nursing databases
2. Adverse events
3. Nurse staffing
4. Nursing practice environment

Appendix E

In-press Articles & Presentations

Do you have any articles or presentations 'in press' ☒**yes** ☐ **no**

If yes, provide copies and all PAO clearance information. All citations listed must be in APA format.

Appendix F

Public Affairs Office Clearances

Appendix G